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SAJOUS'S
ANALYTICAL CYCLOPÆDIA
OF
PRACTICAL MEDICINE

BY

CHARLES E. de M. SAJOUS M.D.

AND

ONE HUNDRED ASSOCIATE EDITORS

ASSISTED BY

CORRESPONDING EDITORS COLLABORATORS
AND CORRESPONDENTS

Illustrated with Chromo-Lithographs Engravings and Maps

Second Revised Edition

VOLUME II



PHILADELPHIA

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1903

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PREFACE.

THE majority of the sections included in the first volume, as stated in the preface of the latter, were prepared under the immediate supervision of the editor and submitted to the various members of the associate staff for revision and correction. Each associate enjoying the privilege of erasing, changing, and adding anything he chose, the correctness of the views advanced was insured, while the innovations as to form introduced by the editor could satisfactorily be carried into effect. The second volume inaugurates the regular plan of the work as regards elaboration: all the articles have been prepared by their respective editors, and the result shows the kind interest taken in the work by all the members of the staff, to whom the editor extends expressions of sincere gratitude.

The aim of the editor is not only to facilitate the labor of the practicing physician and to assist investigators and authors in their researches, but he also seeks to elucidate, through contributions from men possessing special knowledge or unusual experience in a particular line, diseases which, owing to their complexity, are not generally understood. This plan has borne fruit, and the readers will have before them, in this volume, exceptionally-valuable articles on a number of exacting subjects, namely: "Cerebral Hæmorrhage," by Dr. William Browning, of Brooklyn; "Cirrhosis of the Liver," by Professor Adami, of Montreal; "Cholera," by Professor Rubino, of Naples; "Cholelithiasis," by Professor Graham, of Toronto; "Diabetes," by Professor Lépine, of Lyons, etc. The better-known affections have also been edited by writers of special ability. Among the articles of this kind is that on "Diphtheria," by Drs. Northrup and Bovaird, of New York, who contribute a masterly review of our present knowledge of this affection from every stand-point. The papers by Professor Bondurant, of Mobile, on "Chorea"; Dr. Norman Kerr, of London, on "Cocainomania"; Dr. Oliver, of Philadelphia, on "Cataract"; Prof. Nathan S. Davis, of Chicago, on "Constipation"; Dr. Vickery, of Boston, on "Dilatation of the Heart," are, among others, particularly entitled to the readers' special attention. An infirmity but little studied by the general practitioner is "Deaf-mutism." A section giving an exhaustive review of the subject has been contributed by Dr. Holger Mygind, of Copenhagen, one of the greatest living authorities upon the pathogenesis of this condition.

Repeated inquiries having reached the central department as regards the authorship of the fifty-page article on "Animal Extracts" which appeared in the first volume, the editor wishes to state that he wrote it himself, and that he fully appreciates the kind expressions relating thereto, and also the many encouraging reviews which the medical press has accorded the first volume.

THE EDITOR.

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SAJOUS'S ANALYTICAL CYCLOPÆDIA OF PRACTICAL MEDICINE.

C

CATARACT.—Gr., *καταρακτης*; from *καταράσσειν*, to fall down.

Definition.—By the term “cataract” is meant an opacity, partial or complete, of the crystalline lens.

Varieties.—The opacity of the crystalline lens may be (*a*) primary or idiopathic, (*b*) secondary to diseases of other ocular structures, and (*c*) symptomatic of other disorders.

Symptoms.—The objective symptoms vary according to the variety of the cataract, being mainly dependent upon the extent, the character, and the density of the lenticular opacity.

In the immature forms the anterior chambers may be shallower than normal, this being due to a forward protrusion of the iris, produced by a swelling of the lens. In hypermature cataract the anterior chamber may become deep, while in the mature condition it is practically of normal size.

The mere inspection of the pupil without the aid of oblique illumination does not always give conclusive evidence in regard to the presence of cataract; yet, generally, especially in fairly-advanced cases, the pupillary area appears dull gray or glistening white, according to the character, the condition, and the age of the lenticular opacity; a condition,

however, that needs careful clinical confirmation before any certainty as to diagnosis can be vouchsafed. At times the pupil may appear almost entirely black or brown in tint. In some, particularly indeterminate cases of this type, the catoptric test is of value. Very rarely, glistening polychromous, crystalline masses may stud the pupillary area.

Study of the eye-ground in the incipient stages will frequently, especially in comparatively young and ametropic subjects, reveal coarse local changes connected with the uveal tract. In all cases, except when contra-indicated, and in all stages, mydriatics should be resorted to, to make as thorough a study of the intra-ocular conditions as possible. Vision is always disturbed to a greater or less degree, according to the situation, the extent, and the nature of the opacity.

Examination, with Dr. Rogers, of records of last 250 cases of cataract of all forms seen jointly in the last three years, and, excluding juvenile, lamellar, and traumatic cataract. Forty-six found among patients still young enough to have active ciliary muscles. Thirty-seven of these had practically normal vision, ranging from 5-6 to 5-5, when their refraction errors were corrected, and almost all came complaining of asthenopia rather than of dimness of vision. A minute examination by means of ob-

lique illumination revealed small clouded areas in the peripheral layers, sometimes few in number and sometimes numerous, or minute points of opacity scattered throughout the lens-substance in such a manner as to make it seem incredible that in spite of this obstruction the patient had vision of 5-5—or average normal acuity. C. F. Clark (Columbus Med. Jour., July 19, '98).

Attention called to error frequently made in hasty diagnosis of senile cataract by general practitioners, who misinterpret the reflection of light by transparent lenses in elderly persons, and particularly in those belonging to the African races. The gray color of the pupil is often misleading, and may influence the physician to express his opinion that cataract is present, when further examination with oblique light and with the ophthalmoscope will convince him that his diagnosis is erroneous. Hansell (Phila. Polyclinic; Georgia Jour. of Med. and Surg., Sept., '98).

The subjective signs are fairly constant in all forms of cataract. Large, circumscribed, peripherally-seated opacities are much less destructive to sight than small ones, or even faint nuclear haze situated opposite the pupillary area. Nearly always during the formative period, motes, "veils," and "cobwebs" are spoken of, while at times multiple and distorted vision is the chief complaint. As the lens becomes more opaque, however, the sight becomes more and more reduced, until, eventually, any large objects can no longer be discerned, although if the condition be uncomplicated, the distinction between light and darkness remains.

During the incipient stages of cataract it frequently happens in the aged that they are able to dispense with lenses ordinarily used for near-work, and at times require concave ones for distant vision. This, which is due to an increase in the refractive power of the eye, consequent upon swelling of the lens, before any

opacity makes its appearance, is known as "second sight." Pain and photophobia, which are best relieved by smoked glasses, are rather infrequent symptoms in the early stages, and are referable to the pressure of the swelled lens on the ciliary body and iris.

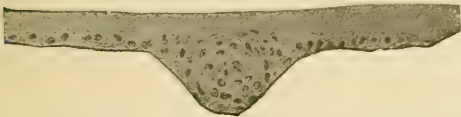
As already stated, there are three varieties of cataract: (a) primary or idiopathic, (b) secondary to diseases of other ocular structures, and (c) symptomatic of some systemic disturbance.

In two of three cases which had been struck by lightning cataract developed in both eyes two days later. Both patients, one a boy of 13 and his brother 11 years old, had been unconscious, the former for a short time, the younger for two days. Linear extraction was performed in both, with success. In the third case, a man of 24, unconsciousness had lasted ten minutes only. Some time later a cataract developed in the right eye. Extraction with iridectomy proved successful. Comparatively few cases of cataract due to lightning-stroke have been described in literature. Joseph Preindlsberger (Wiener klin. Woch., Mar. 28, 1901).

A cataract may remain permanently limited to some particular portion of the lens, or it may gradually involve the entire lens-substance and lead to complete opacification.

The former variety, which is divided into several types, dependent upon the locality of the lens involved, may be either congenital or acquired. When the opacity is situated in the anterior pole of the lens, the condition is known as anterior polar cataract or anterior pyramidal cataract. The cause of the congenital form is supposed to be due to some foetal disturbance operating during the development of the lens. In the polar variety, which, in reality, is one of the true cataractous forms, the opacity assumes the figure of a star or rosette, with its radii extending toward the pe-

riphery. It has been seen to follow contusions of the globe, to appear as a part of pigmentary retinitis, and exhibit itself as a consequence of uveitis. The post-natal form, as a rule, is the permanent result of rupture of a corneal ulcer, by which the anterior capsule of the lens is brought into contact with the inflamed cornea, leading to prolifera-



Capsular cataract. (*Becker.*)

tion of the epithelial cells of the lens occupying the position of the pupillary area, with the formation of a subcapsular opacity after the reformation of the anterior chamber; this being in addition to the nebule, which, as a rule, but faintly marks the site of the previous corneal ulceration. When, in addition, there is a deposition upon the anterior face of the capsule which in itself is irregular, opaque, and thickened directly beneath, the condition is known as anterior pyramidal cataract: in reality an opacity in both the lens and its anterior capsule. The disturbance in vision depends upon the extent of the capacity. Treatment, as a rule, is unavailing, except the possibility of an optical iridectomy should the opacity be large and the pupil small.

When the opacity is situated at the opposite pole of the lens, the condition is designated as posterior polar cataract, or posterior pyramidal cataract. In most instances the latter form, which is not a true cataract, is congenital in type, and is due to some interference with the incomplete disappearance of the hyaloid artery. It is recognized as a small dot or point on the posterior capsule at the posterior pole of the lens, projecting

backward into the vitreous humor. True posterior polar cataract is, at times, found as the initial point of election of the senile form, and is not infrequently seen associated with uveal disorder associated with lymph-stream disturbance and liquefaction of the vitreous body. Generally it appears in the stellar form of opacity. In this variety interference with vision depends not only upon the size of the opacity, but also upon concomitant and relevant changes. Treatment, to be of any avail, must be directed, if possible, toward any existing cause.

A third form, although separated into quite a series of groupings, consists of localizations in various parts of the lens. Opaque stripes extending from pole to pole, and often combined with the central and the zonular forms, are known under the name of "spindle-shaped" or "fusiform" cataract. Minute dots, usually mostly situated in the central portion of the lens, and frequently grouped in the anterior cortex, are known as punctate cataract. Small spheroidal

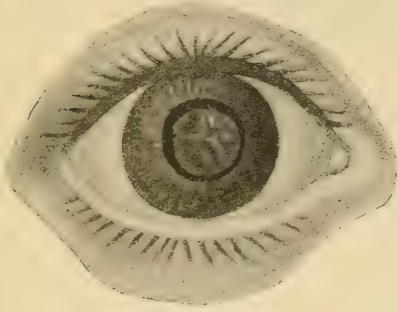


Posterior cortical cataract. (*Sichel.*)

opacities in the nucleus, of congenital type, have, by some, been described as central cataract. As a rule, they are all mere concomitants of gross intra-ocular pathological change.

Zonular opacities situated between the nucleus and the cortex of the lens, both of these portions being transparent, are

not uncommon. At times they may progress as a series of minute opaque processes, or "riders," as they are termed, rendering the entire lens opaque. This variety of cataract, also known as perinuclear or lamellar, is either congenital



Congenital cataract with riders. (*Sichel.*)

or forms during infancy in rachitic subjects or those who have been affected with convulsions. Usually it is binocular, but it may occur in but one eye, and almost without exception is but very slowly progressive, though cases in which the opacity has become total have been reported. Upon account of the situation of the main opacity or opacities, vision is usually markedly disturbed, necessitating either artificial mydriasis, iridectomy, or lens-removal.

If the appearance of the lens shows that the opacity is probably stationary, and if the zone of the opacity be not so broad that, after the pupil has been dilated with a mydriatic, vision is bettered, it is advisable to expose a portion of the transparent periphery of the lens by an iridectomy, thus obtaining an eccentric clearer pupil through which the subject can look. If, on the other hand the peripheral zone of transparent lens-matter be narrow, and if there be evidences of increase in the cataract, it is preferable to remove the lens, either by extraction, when the nucleus is well

hardened, or by discission, when the lens-matter appears soft.

TRAUMATIC CATARACT.—As a rule, this form of lenticular opacity is the result of a rupture or disturbance of the capsule of the lens from an injury which permits the aqueous or vitreous humor to come into contact with the lens-fibres. The laceration in the capsule may be caused by either direct injury by means of the penetration of a foreign body or indirectly by contusion.

Shortly after the capsular laceration the lens-fibres near the rent begin to cloud and swell. Later, if it be the anterior capsule that is injured, they ooze out into the anterior chamber, appearing as gray, fluffy-looking masses. The aqueous humor, however, soon dissolves the lens-masses that have passed into the anterior chamber, and, gaining freer access to the interior of the lens by the removal of the primary plugs of lens-matter, causes more or less of the lens-substance to become opaque, swelled, and absorbed. In this way, after the



Congenital, nuclear, and perinuclear cataract. (*Sichel.*)

lapse of some time, the major portion of the lens-substance may be dissolved and the pupil again become almost black. In most cases, however, the capsular wound cicatrizes and becomes closed, stopping the process of absorption before the removal of the lens-material by the

spontaneous-liquefying method is fully attained.

Many cases of traumatic cataract pursue their course with but few signs of inflammation, but a successful termination is often prevented by the development of iritis caused either by direct injury or by pressure of loose or swelled lens-matter. Septic matter may be also introduced into the eye either at the time of the traumatism or later, giving rise to iridocyclitis, panophthalmitis, and even periophthalmitis. If not prevented it not infrequently happens that secondary glaucoma supervenes. This condition is generally due to either a blocking of the angle of the anterior chamber by pressure or the presence of a mass of lens-matter obstructing the passage of the aqueous humor through the spaces of Fontana.

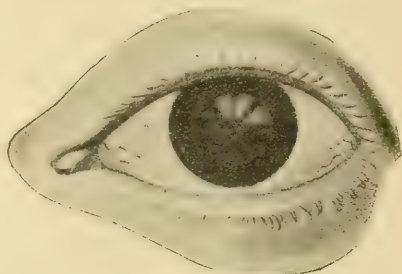
The increasing forms of cataract are roughly divided into four stages. As a rule, they begin in isolated areas, but increase and multiply until all of the lens-substance is affected. The most frequent form is that known as senile cataract.

In the first, or incipient, stage the opacities usually begin in the periphery of the lens. They appear either in the form of spots or of stria, which radiate from the lenticular equator toward the centre of the lens. This condition is known as cortical cataract. In other cases the nucleus of the lens may become quite hazy and opaque, while the periphery may remain comparatively clear. This variety is ordinarily designated as nuclear cataract. In most instances, however, the two forms, in which both the cortical and the nuclear portions of the lens are affected, are associated.

Clinically, in the stage of development of the cataract the anterior chamber will be found but slightly shallowed or of

normal depth, and the opacities will, by oblique illumination, appear as white or gray streaks and sectors with dots.

In the second stage, or that of ripening, the lens is swelled, this being due to the fact that it contains an increased quantity of fluid. The opacities are more pronounced, while numerous clear spaces are scattered throughout the lens-substance. As a rule, the anterior surface of the lens has an iridescent, bluish-white appearance. The anterior chamber is shallow. Clear spaces situated in the lens between the iris and the opaque portions of the lens-substance can be recognized by oblique illumination, allowing a shadow of the iris to be cast



Well-advanced cortical cataract. (*Sichel.*)

upon the lens at the side from which the light is thrown.

In the third, or mature, stage the lens has returned to its normal size, this being, in great measure, due to the loss of the lenticular fluids by resorption. The clear spaces in the lens-substance are replaced by opacities, and the anterior chamber has regained its normal depth. The iris fails to cast a shadow. The lens presents a dull-gray or waxy appearance, and its anterior face is seen to be situated on a level with the pupillary margin of the iris. Should the pupil be artificially dilated, it will be found that the red reflex from the fundus, which can be dimly obtained

while the cataract is in its immature stage, is lost.

In the fourth, or hypermature, stage, as a rule, one of two changes occurs: either the cortical substance disintegrates and becomes fluid, while the nucleus remains hard,—so-called “Morganian cataract,”—or the broken-down cortical substance becomes more greatly inspissated and dries into a hard and somewhat flattened mass.

In hypermature cataract the anterior chamber is of normal depth, the iris fails



Section through Morganian cataract.
(Becker.)

to cast any shadow, and the surface of the lens appears either homogeneous or exhibits irregular dots in the situation of the ordinary physiological sectors. If, however, the overripening process be more advanced, fatty and calcareous degeneration occurs in the lens and its capsule, the anterior chamber becomes deeper than normal, and tremulousness of the iris can be seen.

In Morganian cataract the nucleus

may sink to the bottom of the liquid contents contained within the lens-capsule, the walls of the capsule may come in contact with one another, and the volume of the lens-mass become increasingly smaller until nothing but a thin, transparent membrane remains: so-called “membranous cataract.”

Practically, according as the dimensions of the nucleus of the lens vary, a cataract is spoken of as hard or soft. When there is no hard nucleus the cataract is said to be soft; so that, as a rule, all cataracts occurring in persons under 35 years of age fall under this category. In older subjects, however, the lenticular nucleus is larger and more or less sclerosed; so that opacities occurring in such persons are designated as hard cataracts, although the cortices of such lenses may be quite soft.

In some senile cataracts the general sclerosis becomes so pronounced that the entire lens is involved in it. In such a condition the cataract, as a rule, appears a dense, reddish brown and markedly translucent. This variety is usually termed “black cataract.”

SECONDARY CATARACT.—This condition refers to the changes that are, at times, observed in the capsule of the lens following, for example, extraction of cataract. It is frequently seen after the attempted removal of an immature cataract in which a portion of the lens-substance remains. This occurs when the capsular membranes become agglutinated together and the escape of any remaining lens-material is prevented. In many instances it happens that the entire pupillary area is not covered by the opacity, and fairly-satisfactory vision may be obtained.

When the condition does not develop until some months after the primary operation for extraction, it is generally de-

pendent upon a fresh proliferation of the epithelial layer, with reduplication of the capsule.

Etiology.—Congenital conditions operating upon the causation of cataract, which, at times based upon well-founded clinical observation, have been determined to be hereditary in type, practically resolve themselves either into developmental disturbances in the eye or antenatal inflammatory reaction of the organ.

The influence of heredity in the production of cataract traced through six generations. In no instance was there any evidence of consanguinity. The transmission was effected by females alone. Fromaget (*Gaz. Hebd. des Sciences Méd. de Bordeaux*, July 30, '93).

Senile change does not produce cataract, but predisposes to it; the efficient determining causes are both ocular and general, while the general causes are not particular diseases, but the conditions arising in the course of disease. Jackson (*Universal Med. Journal*, Dec., '93).

General disease, independent of senility, particularly if of vascular or lymphatic type, becomes, at times, a causative factor. Thus, diabetes mellitus is responsible for about 1 per cent. of cases, this variety being bilateral and developing rapidly. Rachitis, nephritis, and some affections of the skin are credited with the production of the condition.

Cataract affecting primarily the posterior pole and cortex is not uncommon in association with retinitis pigmentosa and other diseases of the pigmentary coat of the eye; but, apart from these conditions, the presence of this variety of opacity of the lens is strongly indicative of the presence of some serious interference with proper tissue metabolism, and, of all such alterations, by far most frequently of diabetes. The special form which the variety takes is that of a rounded central posterior polar opacity, along with the formation

of striæ in the posterior layers of the cortex, these striæ being broad at the equator of the lens, with their apices pointed to the posterior polar region. These striæ become broader and broader at the expense of the intervening clear portions, and then the opacity spreads to the anterior cortical layers, and last the central portions become non-transparent. The author thinks that there



Formative changes in a degenerating lens.
(Becker.)

is quite a sharp line of distinction into two classes of cataract in regard to this matter. In one, the anterior cortex is affected before the posterior; this is the ordinary senile cataract. In the other the posterior cortex and pole are affected first, as described above; this is the form associated with choroidal disease and metabolic anomalies. Klein (*Wiener klin. Wochen.*, 45, 1901; *Ophthalmic Review*, April, 1902).

Certain tonics, such as ergot and naphthalin introduced into the system, are eminently causal in character.

Local diseases and traumatism frequently produce all forms and varieties,

especially in changes affecting the lymph-stream formation and circulation, and where the solvent power of the lymph-fluids can be made to exert their influence directly upon the unprotected and exposed fibres themselves.

Influence of astigmatism in the genesis of cataract: in 33 cases of bilateral cataract, 20 were found in which the more astigmatic eye first became cataractous, 5 were seen in which the less astigmatic eye was first affected, and 8 in which astigmatism was either absent or equal in the two eyes. Astigmatism should not be considered a cause of cataract, but rather as simply a condition which favors its development. Roure (*Recueil d'Ophthal.*, Jan., '95).

Attention called to the frequency of hard cataract in bottle-finishers, who are exposed to the brilliant light and intense heat of a furnace during their working hours. Both eyes are practically always affected. The disease begins early in life and progresses slowly. It usually starts as a posterior polar cortical cataract. The disease can be prevented by wearing dark-blue spectacles. Six cases are reported. Robinson (*Brit. Med. Jour.*, Jan. 24, 1903).

Pathology.—By most recent authority, cataract is said to be, as a rule, caused by a too-rapid sclerosis and shrinkage of the nucleus. As one of the results, a cessation in the growth of the surrounding lens-fibres takes place. These separate from one another at certain places, especially in the area between the nucleus and the cortex, and particularly in the equatorial region of the former, producing fissures or cavities that gradually become filled with an albuminous liquid, which coagulates and produces spheroidal bodies known as the spheres of Morgagni. Later, the lens-fibres which constitute the walls of the fissures become translucent and unequally swelled, giving rise to large and mostly nucleated vesicles of varying

sizes and shapes. After total disintegration of these fibres and cells with their remains has fairly well taken place, the epithelium of the lens becomes abnormally thickened, the most peripheral lens-fibres become vacuolated, and the capsule of the organ becomes abnormally separated by the pathological process at work. In contrast to this breaking-down of the cortex, the shrunken and hardened nucleus, as a rule, remains practically unchanged.

In the various forms of congenital cataract the course of events may probably be traced in this manner: An inflammatory process has attacked the different eyes in varying intensity; the ribbon-like opacity which each cornea bears as an evidence of this is most marked in the eyes with most posterior synechiæ and capsular cataract. Following the disturbance in nutrition produced by the inflammatory attack, the capsular epithelium and lens degenerate, and, in consequence of shrinking processes, rupture of the posterior capsule ensues. The gap is filled up by a capsular cataract, and thence arises an adhesion of capsule to lens-substance. In one case witnessed occlusion did not take place and the lens-fibres grew outward. After the inflammatory process had run its course (and it lasted a variable time in the different cases) lens-fibres were developed, the plentifulness and quality of which depended on the condition of the epithelium. E. V. Hippel (*Von Graefe's Archiv f. Ophthal.*, liv, 1, 1902).

Prognosis.—The diagnosis of cataract being once established, it frequently becomes necessary to be able to decide how long it will take for the cataract to become mature, or what is known as "ripe." This is very difficult, as the rate of progress is extremely variable. Senile cataracts may require years to become sufficiently opaque and hardened for operative interference, while, on the contrary, in a few rare instances, they

have ripened over night. It is generally wise, therefore, if the signs of cataract be discovered in elderly persons not to alarm them by telling them of its existence, as vision may not be seriously disturbed for a long time. Particularly is this so in nervous females in frail health. Under all circumstances, however, it is better that the diagnosis be communicated to some responsible friend or relative of the patient. At times, among men especially, those who are harassing themselves with monetary and business affairs, it is best to acquaint them with the nature of the disturbance in order that better hygienic living may be obtained.

As a general rule, cataracts in the young, those due to general dyscrasia, and the secondary forms, all develop rapidly. On the contrary, all forms of opacity which commence in the periphery as narrow radii are slower in extension than those in which there are dot-like and broader opacities.

In reference to the prognosis of the result of operative interference for the removal of cataract, numerous factors must be taken into consideration. In many cases it is essential to determine the probable condition of the interior of the eye by means of the so-called candle-test. No matter how dense a cataract may be, a patient with a healthy fundus should be able to recognize the position of a candle-light placed in all parts of the visual field while the organ is constantly directed toward a second candle situated at a central fixation-point. If the moving light be lost at any point in the field, a disturbance of one or more of the ocular tunics may be diagnosed with almost certain precision and the prognosis rendered relatively unfavorable. If all light-perception be lost, operative procedure would be useless. The

condition of the appendages of the eye must be noted, and any disease of them should be carefully treated.

The state of health of the patient should be good as possible. General dyscrasia and old age do not contraindicate operative interference, although they render the chances of a successful termination somewhat less.

Profound anæmia, depressed mental conditions, and pulmonary complications, on the other hand, are all extremely apt to militate greatly against any operative success.

The surroundings of the patient, the character of the place of operation, the time of year, and the hour of the day must all be taken into consideration. The more aseptic the conditions under which the operation is to be performed, the greater are the chances of a successful termination; in fact, this is the greatest of all the prognostic factors. Operations performed in hospitals are much more certain to be successful than those which are performed in private houses.

In regard to the effects of the character and the condition of the cataract itself upon the prognosis, the general rule is that the more nearly mature the cataract is, the more certain are the chances of resultant good vision. In some very old subjects, where the nucleus of the lens is large and well sclerosed, extraction may be made with every chance of eventual success. Operations upon overripe cataracts are not apt to be very successful. The frequency of fluid vitreous, the degenerate condition of the zonule, and the density of the capsule, all are serious complicating conditions.

Reports of 400 extractions of senile cataract by Prof. von Rothmund, of which 25 were complicated: The visual

acuity was satisfactory (at least $\frac{1}{10}$) in 63.5 per cent.; 1.7 per cent. were total failures. Prognosis: while positive response to the usual tests is in general favorable, it does not absolutely exclude disappointments. Thus, in 1 case with normal function to ante-operative tests, an old detachment of the retina was found after extraction. On the other hand, 5 cases with complete lack of power to recognize colors resulted in good vision and presented no complications whatever. Of 39 cases of hypermature cataract the vision was satisfactory in but 18; in 10 cases of adherent cataract the result was satisfactory in 5. Ebner (*Münch. med. Woch.*, vol. xlv, Jährg. No. 16, '97).

As long as a person has the capacity to read with the fellow-eye, it should be let alone. The moment he is not able to read with the other eye, an extraction should be performed, with the understanding that almost certainly a subsequent needling operation of the opaque capsule might be safely undertaken. Dudley S. Reynolds (*Ophthalmic Rec.*, June, '98).

Treatment.—The removal of cataract can be secured only by operation. Reported instances of its cure by absorption, by means of drugs, or by massage are misleading, and usually emanate from persons or institutions devoted to the purpose of mere monetary gain. It is probable that the temporary visual improvement which is, at times, obtained by such patients is due to the instillation of a mydriatic, for, if the opacity be central, dilatation of the pupil may be rendered sufficiently large to remove the iris from before the clear periphery of the lens, thus permitting vision through the unobstructed portion of the lens. Unfortunately, however, the improvement, which, at best, is but temporary, lasts only during the time of the effect of the drug.

Cataract apparently checked for eighteen months and for two years by twice a day instilling a couple of drops, or

applying, with an eyecup for from one to two minutes to the open eyes, 2.5-per-cent. solution of ether iodide, which is readily absorbed. Badal (*La Semaine Médicale*, Nov. 31, 1901).

Three cases of cataract treated by iodide of potassium and sodium wash. These are applied in a cup for a few minutes, with the eyelids wide open, twice a day. By this treatment a cataract fails to progress further and remains stationary. Badal (*Jour. de Méd. de Bordeaux*, July 21, 1901).

Potassium iodide has a marked effect upon opacities of the crystalline lens, in that it stays their progress. It also promotes retrogression of traumatic lenticular cataract. Its influence is very slight in traumatic opacities of the capsule. L. Verderau (*Revista de Ciencias Médicas de Barcelona*, Jan., 1903).

The development of cataract may be retarded by careful and repeated correction of any existing anomaly of refraction and by constant care of the patient's general health.

OPERATIONS.—There are two operative methods of treating cataract: one by absorption and the other by extraction. The first is applicable to soft cataracts only, and is consequently limited to those found in young subjects. It has for its object the bringing of the aqueous humor into contact with the lens-fibres by means of an artificial opening made in the anterior capsule of the lens. This is accomplished by entering a needle, especially prepared for the purpose, through the lower and outer or upper and inner quadrant of the cornea, and incising those portions of the anterior capsule of the lens which are situated opposite the pupillary area.

The pupil should have been primarily dilated as much as possible with some efficient mydriatic. Care should always be taken, particularly in very young subjects, that the capsular incisions are not made too extensively and that they do

not penetrate too deeply into the lens-structure, in order that the lens-mass may not be disturbed too greatly.

General anæsthesia is not necessary. The instillation of a few drops of a 2-per-cent. solution of hydrochlorate of cocaine is sufficient to render the operation painless. The patient should be placed in a recumbent position and the eyelids should be separated either by a speculum or by an elevator and the fingers of an assistant. After the procedure a few drops of sulphate of atropine should be instilled into the conjunctival *cul-de-sac* and ice-compresses applied until the eye becomes free from any signs of operative irritation.

If no complications arise and there be sufficient reason, the operation can be repeated as soon as the absorption of the loosened cataractous masses seem to have been sufficiently accomplished and the mass itself has become stationary. The incisions in the second and any subsequent operations may be made more freely, as the danger of swelling of the lens-fibres is lessened, this being due to the diminished volume of the lens-material. In uncomplicated cases the absorption of the cataractous masses is generally accomplished in eight or ten week's time.

It is concluded that: 1. Certain lenticular opacities, most often situated in the naso-inferior quadrant of the lens, occasionally are practically stationary and may be designated "non-progressive." They do not handicap the patient's ocular abilities, and may with propriety be separated from the class to which the name incipient cataract is ordinarily given. 2. Certain lenticular opacities undoubtedly depend on what may be designated "disturbances of the choroid," as apart from active and actual choroiditis; and their progress is sometimes apparently checked by measures—optical, local, and general medicinal—which restore the choroid coat to normality.

Such measures do not, however, remove from the lens the opacities which have already formed when the patient comes under treatment. 3. Certain lenticular opacities which appear in association with diabetes mellitus, nephritis, lithæmia, and arteriosclerosis, particularly the last two diseases, are sometimes apparently retarded, like those in No. 2, by measures which are suited to the patient's general condition in connection with local and optical therapeutics, but these measures never dissipate the lens lesions already present. 4. The extraction of unripe cataracts is preferable to any of the ordinary operations for ripening cataract. 5. There is no evidence that electricity has the slightest influence in checking the rate of progress of incipient cataracts, or in dissipating the opacities which have formed. 6. There is very insufficient evidence, if any, that massage of the eyeball favorably modifies the rate of development of cataract. 7. There are no "specific remedies" for the treatment of cataract, and there is no reliable evidence that drugs exist which cause the absorption of partially or fully formed cataracts. 8. All lenticular opacities, unless the "non-progressive" group, should indicate a thorough investigation of the patient from the general as well as the ocular stand-point, and the employment of remedies according to the findings. G. E. de Schweinitz (Jour. Amer. Med. Assoc., Dec. 8, 1900).

The principal complications of the procedure are iritis and secondary glaucoma. The first is supposed to be caused either by pressure or "chemical irritation" exerted by the lens-matter on the iris. As a rule, it may be prevented by keeping the pupil well dilated with some powerful mydriatic or combination of mydriatics. If the second form of complication appears, the lens-matter should be immediately removed by extraction through a linear incision.

In traumatic cataract the patient should be placed in bed as early as possible. Ice-compresses should be applied either constantly or intermittently to

the eye in order to reduce inflammatory reaction, and atropine should be instilled at regular intervals to prevent the occurrence of iridic inflammation. Ordinarily under such plan of treatment, the lens-substance will gradually absorb without any complicating disturbances. The danger of secondary glaucoma with its accompanying symptoms should never be lost sight of, and intra-ocular tension should be repeatedly tested. If such symptoms should intervene, as much of the lens-matter as proper at the time should be removed without delay. This may be readily accomplished by a simple incision through the cornea into the anterior chamber and the softened lens-masses carefully and gently coaxed out along the groove of a Daviel spoon.

In operating upon shrunken or membranous cataracts, it is not so essential to provoke absorption of the remaining cataractous material as it is to obtain a clear space in the toughened and opaque capsule through which vision can be gotten. The operation is ordinarily performed by means of two needles which are passed rather obliquely through the cornea, one near to the nasal and the other close to the temporal border of the membrane. This done, both are pushed backward into the chosen portion of the opacity, and the points of the instruments separated from one another in such a manner that no traction is exerted upon the iris and ciliary body, thus producing a clear hole in the membranous mass.

Complete atropinization of the eye before extraction of cataract is extremely favorable to the successful issue of the operation. Confirmed by a trial of the method in 170 cases. Out of these, prolapsus of the iris occurred only in 7 cases,—*i. e.*, 4 per cent., while before the use of atropine the percentage of pro-

lapsus was 15. Muttermilch (Gazeta Lekarska, No. 9, '96).

Simple linear extraction is applicable to the removal of both the soft and the membranous varieties of opacity. It is preferred by many operators to discission, and may be employed in any case where the lens-substance is sufficiently soft to flow through a small corneal wound.

The operation is performed as follows: After a speculum has been inserted, or the eyelids separated by an assistant, the globe is grasped by a fixation-forceps, and the point of a keratome or the tip of a von Graefe knife is entered into the anterior chamber through the cornea, usually about three or four millimetres from the limbus. If the former instrument is used, it is passed directly through the corneal membrane, but, as soon as its tip enters the anterior chamber, the cutting-blade is laid upon a plane that is parallel to that of the iris. It is then pushed forward until the corneal wound has obtained a length of several millimetres. It is then slowly withdrawn, in order to prevent the aqueous humor from coming away too quickly, with the possibility of a prolapse of the iris. If a von Graefe knife is used, the movements given to the instrument must be very carefully performed, in order to avoid wounding the iris-tissue. A cystotome is passed into the anterior chamber through the same corneal wound, care also being taken to avoid wounding the iris. Free incision in the anterior capsule of the lens is then made with it. After the incisions have been accomplished, the cystotome is withdrawn, and the loosened lens-matter is evacuated, as previously explained, by means of a Daviel spoon. If necessary, the operation may be done with the addition of an iridectomy. In

this event, the corneal incision is made nearer the limbus and should be slightly longer. After the withdrawal of the knife, the tips of an iris-forceps are to be introduced into the anterior chamber and a fold of iris directly over the sphincter of the pupil grasped and gently drawn through the wound and cleanly snipped off with a pair of fine scissors. Cystotomy and extraction of the lens-massings then follow, a just detailed.

As it frequently happens that lens-matter is left behind, a number of operators practice its removal by suction-syringes of special construction. The procedure, however, has never obtained general favor.

The operation for the removal of a hard cataract consists essentially of three steps: the corneal incision of sufficient size to permit of the passage of the lens; an incision, or a series of them, into the anterior capsule of the lens (cystotomy) in order to allow the egress of the lens-matter through it; and the delivery of the lens-substance from the eyeball itself. Before the actual operation is made, certain preliminary details should be carefully attended to. A general warm bath should be given to the patient the night before the operation. Care should be exercised to make his head clean with Castile soap and water. The bowels should be relieved by a gentle laxative, in order that they may not be disturbed for the first few days after the operative procedure.

The instruments, with the exception of the knives, which should be immersed in alcohol for at least twenty minutes prior to their use, should be boiled. After the cleansing has been completed, they should be kept in a tray of alcohol during the entire operation, being dipped for a few moments in a tray of sterile

water just as they are being picked up for use.

The patient having been carefully prepared and the field of operation having been excluded from external contamination for a couple of hours previously by a few turns of a roller bandage, his eyelids, eyebrows, eyelashes, and adjacent parts should be thoroughly washed with a saturated solution of boric acid. The lids should be gently everted and the upper and lower *cul-de-sacs* flushed with the same character of solution. Several drops of a 2-per-cent. solution of hydrochlorate of cocaine are then introduced into the eyes at five-minute intervals, for about fifteen minutes before the operation, care being taken that the eyelids are kept closed and that a clean towel is thrown over the field of operation. If possible, the patient should lie flat on his back in the bed that he is to occupy. If circumstances do not permit this he should be placed upon some form of operating-chair or table. The source of light should be situated so that there shall be a field of uniform illumination upon the exact points to be operated upon. If the surgeon be ambidextrous, he may place himself in front of the patient or behind him in accordance with comfort and existing circumstances. A trained assistant should be present and assume such a position that he may be able to hand the instruments to the surgeon or receive them from him with such skill and rapidity that the operator may be able to keep his vision fixed upon the field of operation during the successive stages. Prior to any procedure it is well for the surgeon to speak kindly and quietly to the patient for a few moments to gain his confidence and at the same time inform him of certain movements of the eyes that may be necessary during

the operation. He should be cautioned against holding his breath and straining and told to resist all desire to close his eyes forcibly. By these few injunctions quietly and authoritatively given, the most intractable patients may be rendered obedient, the soothing words thus given often bearing fruit to the surgeon a hundredfold.

All these minor, but most essential, preliminaries being satisfied, the eyelids are to be separated by an elevator held in the hands of a skilled assistant, who is capable, if necessary, to momentarily remove the instrument without any damage to the organ. The patient is asked to look down. The globe is firmly held in any desired position by gently taking a fold of bulbar conjunctiva about two or three millimetres' distance from the corneal limbus within the grasp of a fixation-forceps held with one hand, while with the other the corneal section is to be made. The knife most generally employed is one introduced by von Graefe, which consists of a long, straight, narrow blade converging at its far extremity into a sharp point. Unless contra-indicated, the primary puncture should be made just within the margin of the clear cornea at the outer extremity of a horizontal line, which, as a rule, would pass three millimetres below the summit of the membrane. The cutting-edge of the knife should be situated upward and its point directed toward the centre of the cornea. After the tip of the knife has been made to enter the anterior chamber, it should be carried directly across and re-entered into the corneal tissue at the point desired. The section should then be completed by an upward movement so regulated that the corneal section is kept true and smooth throughout its entire extent. At this stage the elevator, in

uncomplicated cases, is removed and not used again. The first stage of the operation being completed, the surgeon next addresses himself to the performance of the second stage, or that of capsulotomy, or so-called cystotomy. Directing the patient to look down and without any fixation-instrument in position, if possible, he introduces a cystotome, with the heel of the cutting-point first, between the lips of the corneal wound, and inserts the point of the instrument into the anterior capsule, without dislocating the lens, in such a manner as to be able to make a series of as free incisions as he may believe desirable and in such positions as he may deem the best. These having been obtained, the cystotome is withdrawn in such a way that the iris is not wounded during the procedure. The avenue of escape for the lens having been made, it remains to practically complete the operation by the performance of the third stage, or that of the delivery of the lens. The surgeon should, with the ball of the finger-tip of one hand upon the sclera just below the lower edge of the cornea, and a spatula held in the other hand and placed upon the sclera just above the corneal section, make a series of delicate, yet steady, upward and forward pressures and counter-pressures until just one-half of the lens has engaged in the corneal wound, when, by a dextrous and slightly tilting and upward motion from side to side, the lens will emerge without any complication whatever, and the corneal flap will fall smoothly into place. Should the pupil not be round and should any lens *débris* be seen, the eyelids are to be closed and a slight gentle rotary motion be made upon the globe through the upper lid by the fingers. If there be any cortex remnants, the stump of the flap is to be slightly depressed and the

masses gently, though as completely as possible, washed out of the anterior and posterior chambers by free irrigation from varying positions with warm sterile water or boric-acid solution without the introduction of any instrument whatsoever into the chambers.

After the lens has been delivered and anything, such as blood-clots and lens *débris*, which might prevent the proper union of the lips of the corneal wound have been removed, the conjunctival *cul-de-sac* is to be flushed with a warmed solution of boric acid and the pupil and corneal flap seen to be in proper positions. The eyelids of both eyes are then gently closed and held together, if necessary, by one or two narrow strips of isinglass plaster.

A few carefully-adjusted and smoothly-applied turns of gauze bandage over squares of sterilized gauze properly covered by pledgets of absorbent cotton should be made without disturbing the patient. Strict injunction to remain quiet for at least twenty-four hours' time should be given, any necessary desires being properly cared for by competent attendants.

Case in which destruction of the eye by hæmorrhage followed the extraction of a cataractous lens, which had been dislocated downward, and which was safely removed by simple extraction without the use of a wire loop or of fixation of the lens. A few minutes after the operative procedure the patient complained of severe pain in the temple and back of the head. An examination revealed the presence of a copious hæmorrhage from the corneal wound, which was at once controlled by placing the patient in an upright position. There was a deep glaucomatous excavation in the other eye, but at no time could any hæmorrhages be observed in the fundus. Jackson (*Annals of Ophthal. and Otol.*, Jan., '94).

The chief factor in the causation of

ocular hæmorrhage after extraction is an increase in the blood-tension. Microscopical examination of an eye, which was lost as a result of such an accident, showed that the choroidal and retinal vessels had very much thickened walls and that there had been a classical total retrochoroidal hæmorrhage. The hæmorrhagic extravasation seemed to have originated at the entrance of the posterior ciliary vessels in the posterior and external regions of the choroid, and did not occur until three days after the extraction of the lens. Terson (*Archives d'Ophthal.*, Feb., '94).

An instance of destructive hæmorrhage during extraction of a cataract: The patient was a female 82 years of age. The liquefied state of the cortical substance, the presence of cholesterin crystals in the lens, the sagging downward of the lenticular mass, the tremulous irides, and finally the very fluid vitreous, all gave indications of degenerative processes which had occurred in the eyes before opacity of the lens had taken place. In this case the prolapse of vitreous followed immediately on the section, and a hæmorrhage appeared instantly after the delivery of the lens. Risley (*Annals of Ophthal. and Otol.*, Jan., '94).

Case of double cataract extraction followed by hæmorrhage, with subsequent restoration of vision: The subject was 71 years old, and in a very poorly nourished condition. He was a sufferer from varicose veins over the whole body and exhibited other evidences of vascular disease. Gasparrini (*Annali di Ottal.*, Oct., Nov., '94).

Intra-ocular hæmorrhage, with subsequent shrinking of the globe, following cataract extraction in a woman, 78 years of age, with degenerative heart disease: The patient died about eight months later from angina pectoris. Lee (*Practitioner*, June, '95).

Five cases in which no cause could be assigned for the hæmorrhage: There was no want of smoothness in the course of the operations except in one case, and this was so slight as to be ordinarily of no significance. Suggestion was made that a preliminary iridectomy is probably a valuable measure in these cases,

and when done such have been reported as successful. Wadsworth (Boston Med. and Surg. Jour., Sept. 3, '97).

Choroidal hæmorrhage after cataract extraction is by no means so rare as has been thought. Over 50 cases have been reported, and many remain unpublished. It is due solely to the diathesis of the patient, the principal cause being an atheromatous condition of the vessels, or an abnormal tension of the eyeball, suddenly reduced by the incision in the cornea and the outflow of aqueous. When such a hæmorrhage occurs the best treatment is to raise the patient's head, to relieve the pain, and to watch the eye carefully, at the same time being prepared to perform enucleation as early as possible. J. A. Spalding (Archives of Ophthal., vol. xv, No. 1, '97).

Local changes in the choroidal veins predispose to post-operate hæmorrhage within the eye. Bloom (Graef's Archives, July 19, '98).

If no pain be complained of, the dressings should be allowed to remain for twenty-four hours, at the end of which time they should be removed, the eye inspected, and the conjunctival *cul-de-sac* gently flushed with a solution of boric acid. If all has gone well it will be found that the anterior chamber has re-established itself and that the eye is quiet. If there be any injection, if the pupil is small, or if any sign of inflammatory reaction be present, a drop or two of sulphate of atropine or, better, hydrochlorate of scopolamine should be instilled. At the end of forty-eight hours' time the dressing over the sound eye may be removed, but that on the operated eye, which can be made lighter, should be allowed to remain for another day, when plain smoked glasses or, if unobtainable, a suitable shade can be worn.

To prevent tendency to prolapse of the iris and to favor smooth healing of the corneal incision, it is essential

that the patient should rest absolutely quiet in bed for the first forty-eight hours. If he be old and feeble, more latitude can be given to his movements, which must be accomplished by the aid of careful attendants. At the end of the second day, a bed-rest may be employed, and on the third day, if the healing has been uncomplicated (which under the circumstances will be so almost without exception), the patient may be allowed to sit up. For the first twenty-four to forty-eight hours the diet, which is to be regularly given, should be liquid and semisolid. On the third day the bowels can be opened by a gentle laxative. After this, liberal nourishment may be ordered.

Although reclinacion of the lens in the very aged at one time was largely employed, and is still to some extent, personal observations at Hirschberg's clinic has shown that extraction is, after all, the most feasible procedure, even very late in life. The author's observations embrace 1645 cases of nuclear cataract, among which there were 36 patients over 80 years of age. Only in 2 cases were the results not entirely satisfactory. Advanced age does not, therefore, offer an unfavorable prognosis for cataract extraction. In very restless patients general anæsthesia may be employed. Delirium will occasionally occur, but the most serious complications are those related to the heart, lungs, and bladder. In one case heart disease gave rise to pulmonary œdema, which, however, was controlled by morphine. Mendel (Berliner klin. Woch., Aug. 12, 1901).

The operation which has just been described is what is known as simple extraction, or extraction without iridectomy and is the one that is ordinarily in use to-day and should be the one chosen in all suitable cases in which there are no contra-indications.

Results obtained in series of 465 cases of extraction: 75.2 per cent. were successful, 9.4 per cent. were partially successful, 7 per cent. were failures, and the results of 7.9 per cent. were not recorded. Nineteen cases in which the patients were 80 or more years of age showed entire success in all but 2 instances, and in 1 of these the success was partial, while in the other, which was a failure, the fellow-eye was lost through sympathetic inflammation. Higgins (*Lancet*, Aug. 11, '94).

One hundred consecutive extractions; extraction without iridectomy preferred; Knapp's method of making the capsulotomy followed. Discussion resorted to in 88 per cent. of private cases and 60 per cent. of hospital cases, the operation being performed about three weeks after extraction. No cause to regret the extraction of an immature cataract. Weeks (*N. Y. Med. Jour.*, Aug. 3, '95).

Study and comparison of 1032 cases of combined extractions and 1123 cases of simple extractions: Conclusion that the simple method extraction is far superior to all others in the very great majority of cases, and that, while it is a somewhat more difficult operation than the combined method, any experienced surgeon will find the results proportionately greater. Ring (*Med. Rec.*, Feb. 23, '95).

Details of 1519 cases in which the operation of extraction was performed during the five years,—1889 to 1893 inclusive,—in the practice of eleven different surgeons: Extractions with iridectomy, 1091, as against 276 in which simple extraction was performed; while 161 had an iridectomy done some weeks at least before the cataract was removed.

The percentage of successful cases only amounted to 83.78, and 13.51 had no useful vision. Of all the 1519 cases the percentage of enucleation after extraction amounted to 1.90. Although needless is, as a rule, such a simple procedure, yet many cases subsequently do badly. Glaucoma occurred in 2.08 per cent. of the cases after secondary operations on the capsule, while it occurred in only 0.42 per cent. of cases after extraction. C. Devereux Marshall (*Royal Lon-*

don Ophthalmic Hospital Reports; *Universal Med. Journal*, Mar., '96).

In looking over notes of between 500 and 600 personal cases, the most successful cataract operations have been those in which it was possible to extract the lens in its capsule and without an iridectomy. In 118 of such cases only 3 eyes were lost. The next best lot of cases are those in which the lens was extracted in its capsule after an iridectomy; out of 91 of these cases only 3 eyes were lost. B. H. Gimlette (*Indian Lancet*, Apr. 16, '98).

Case of a woman, aged 35 years, who was nearly blind. The right eye was undeveloped and there was a capsuloretaceous cataract in the left eye. A very large flap was made and a large iridectomy was performed as a first operation. Thirty-seven days after the first operation the cataract, which was found to be more capsular than retaceous, was removed. Five years after the operation the patient reads the newspapers without glasses; the vision $\frac{2}{10}$, and she wears a 4 or 5 $\frac{1}{2}$ D. for distance. E. L. Parks (*Boston Med. and Surg. Jour.*, Jan. 10, 1901).

Depression of the lens in cataract is indicated in some instances notwithstanding the brilliant results obtained from extraction by modern methods. The classes of cases to which this applies are those in which conditions are present which render it doubtful whether any operation should be undertaken. For example: 1. Those who are greatly enfeebled by age and other infirmities. 2. Where physical obstacles to extraction are present: *e.g.*, small palpebral fissures, small eye, and deeply set in the orbit. 3. Chronic conjunctivitis and dacryocystitis. 4. Considerable degree of deafness. 5. In the insane. 6. Chronic bronchitis. 7. Fluid vitreous, with tremulous iris. 8. Where extraction has been unsuccessfully performed in one eye. 9. In the hæmorrhagic diathesis. Power (*Brit. Med. Jour.*, Oct. 26, 1901).

Many operators, however, still make use of an iridectomy before they expel the lens, justly claiming for this method that it enables them to get rid of any

remaining cortical matter much more readily. They also state that it prevents prolapse of the iris and that the lens may be extruded through a smaller wound.

Those who prefer extraction without iridectomy urge that the advantages of a round, mobile pupil make it the operation of choice. The contra-indications are: an unripe cataract, increased intra-ocular tension, a small rigid pupil, and an intractable patient.

Despite the most careful precautions, prolapse of the iris does occur in a few cases of simple extraction, usually appearing during the first twenty-four or forty-eight hours. If it be small, it may be let alone. If it be considerable, and the lips of the wound remain ununited, the line of corneal incision may be opened and the prolapsed portion of the iris excised with an iridectomy-scissors. Should the prolapse occur after the wound has united, it is best either to wait until about the tenth day, when a formal iridectomy can be made, or, if not productive of any irritation and the pupil is not much distorted, it can remain undisturbed, cicatrization and flattening subsequently taking place.

Conclusions reached from study of last 70 cases operated for secondary cataract are that in 95 per cent. of all cases discission is to be preferred to all other methods of handling secondary cataracts. In the 70 cases improvement of vision was observed in 64, in 5 it remained the same, and in 1 it was somewhat reduced. Discission is justifiable, but there should not be the slightest pulling or tearing with the discission-needle. The knife-needle to cut with, and an ordinary discission-needle to fix with, are the safest precautions against secondary glaucoma after such procedures. Knapp (*Trans. Amer. Ophth. Soc.*, '98).

The greatest breaking up of lens with least escape of lens-matter into anterior chamber in discission-operations is se-

cured by making rent in capsule small, and yet allowing free movement of needle within lens. This can only be done by making the opening in capsule close to opening in cornea. E. Jackson (*Amer. Jour. Ophth.*, Jan., '98).

In certain cases in which complications are feared, or when it is advisable to hasten the maturity of the cataract, an iridectomy known as preliminary iridectomy, can be performed some time before the extraction of the lens is made. If it is desired to ripen the lens after the iridectomy has been performed, the lens may be triturated with a spatula either directly applied to the anterior capsule or indirectly through the cornea. Rapid swelling and opacification of the lens is said to follow these procedures, and the extraction in many cases is made possible in several weeks' time after the operation. The lens-substance, however, in these cases seem to have obtained an undue degree of friability, which may be detrimental to the complete removal of the lens-substance.

Some operators have adopted the method of syringing the anterior chamber after the removal of the main body of the lens, in order to remove any remaining cortical matter. As this plan, however, entails the bringing of another instrument, which may be an additional source of infection, into the eyeball, and is always attended by more or less local reaction, its disadvantages seem to be so many that its employment has never become general.

Details of last 400 personal operations: Incision entirely in the margin of the transparent cornea, in a plane parallel to that of the iris, and with a small conjunctival flap. Corneal incisions tend to be complicated by adherence of the iris and by keratitis; more peripheral incisions are disturbed by prolapse of iris and cyclitis. The conjunctival flap protects against infection of the wound: a

matter of great importance in countries where conjunctival and lacrymal affections are common. The opening in the capsule is made with a cystotome, behind the upper part of the iris near the equator of lens, and is six or seven millimetres in extent. The lens is expressed without introducing a spatula; no instrument of traction is employed even in complicated cases. Reposition of the iris is made by means of a sound or stylet that is slightly curved. Binocular bandage is used. The patient need not be kept in bed. The dressing is changed after twenty-four hours, sooner if necessary; minute inspection of the eye and of the wound; immediate ablation of any prolapse of iris. Knapp (*Annales d'Oculist.*, Oct., '97).

Entire absorption of cloudy lens or capsule-remains may often be accomplished by the use of from 5 to 15 grains of potassium iodide three times daily for several weeks after extraction. Wicherkiewicz (*Woch. f. Therap. u. Hyg. d'Auges*, Sept. 8, '98).

In order to prevent secondary cataract, the lens is, at times, removed in its capsule. This is accomplished by delivering it by a spoon or a loop, after an iridectomy has been performed, without the performance of a capsulotomy. As the operation is, at times, attended by loss of vitreous humor, it is not frequently employed.

Many of the accidents occurring during cataract extraction are the results of want of skill. In some instances, however, it happens that the patient's condition is such that a successful result can scarcely be expected. Deafness, loss of self-control, and great stupidity are all harmful and even injurious at times.

Although planned with the utmost exactness, it sometimes happens that the size of the lens is misjudged and the normal corneal section is made too small. If this occurs, the incision should be enlarged by one or two clean snips with a

scissors. Should prolapse of the vitreous humor take place during the delivery of the lens, an iridectomy had better be carefully done and the lens removed with a loop or a spoon. Prolapse of the vitreous humor occurring after the extraction of the lens is much less serious for the time being. It interferes, however, with the proper coaptation of the lips of the wound and renders inflammatory action more liable, while in many cases it becomes a most harmful complication for the future welfare of the organ.

Usually there is some discomfort for several hours after the operation. Should this continue and be at all marked, the bandage should be removed and the eye inspected. At times great relief will be given by gently pulling down the lower eyelid and giving exit to an accumulation of tears or by allowing a faultily placed eyelash to escape into proper position. If the eyeball appears the least injected and the slightest signs of iritis be present, atropine should be immediately instilled into the conjunctival *cul-de-sac*. Suppuration may appear, usually taking place before the third or fourth day, and is traceable to infection, generally from lacrymal disease. In a few instances it is dependent upon a lack of nutrition to the eye. If it is due to the former, it is best combated by cauterization of the edges of the incision, the instillation of sulphate of atropine, the use of hot compresses, and attention paid to the general health.

An eye whose lens has been removed is termed aphakic, and, in order that its vision may be useful, it must be provided with an artificial lens corresponding in relative strength to the crystalline lens that has been removed, plus a cylindrical one to correct any astigmatism resulting from cicatrization of the cor-

neal incision. To this artificial lens must be added a convex spherical one of two or three dioptries' strength for use during near work. As cicatrization is usually not completed until four to six weeks after the operation, it is better to postpone ordering glasses until at least that time.

Corneal measurements after extraction of cataracts: Conclusions from an examination of 59 cases:—

1. Two weeks after the flap-extraction of cataract there is corneal astigmatism varying from 1.75 D. with rule to 22.0 D. against rule.

2. The greatest amount of this astigmatism disappears in the following four to six weeks.

3. It is slowly reduced for six months, after which it seems there are no further changes.

Bearing these facts in mind, it is evident that an accurate estimation of the ultimate glasses cannot be made at the end of two weeks. A. O. Pfingst (Archives of Ophthal., July, '96).

Case of extraction of cataract in which union was delayed for twenty days. It finally took place, however, with good vision. G. C. Harlan (Trans. Amer. Ophth. Soc., '98).

Analysis of a series of 500 consecutive operations for primary cataract, performed between June 22 and November 2, 1901, a period of nineteen weeks, in the Government Ophthalmic Hospital, at Madras. All but 36 of these operations were done on the Saturdays of this period, making an average of 27 operations for each operating day. On an average of from 12 to 16 patients were operated upon in an hour. In making a section in the sclero-corneal margin, the author endeavors to graduate the section according to the size of the lens. Each patient was inspected and dressed daily after the operation. As little interference with the parts as possible is made after operation. Atropine is used as a routine measure on the third morning after operation, provided there is no contra-indication; the sound eye is unbound on the fifth morning, the eye

operated upon is released on the seventh day if all is going well, and the patient is discharged at this time to report as an out-patient. Stress is laid on the importance of treating any complication that may be present prior to operation. This applies even to slight congestion of the conjunctiva. The author presents an interesting analysis of the complications and of the results obtained in these cases, and closes with the warm commendation of McKeown's irrigating apparatus, which, he states, reduced the vitreous losses in this series to 2 per cent.; by emptying the capsule and chamber of *débris* it has minimized the need for subsequent capsulotomy and has enabled the author to dispense with the introduction of instruments into the eye after the escape of the nucleus; it is of great value in clearing the chamber of fluid; by gently and evenly replacing the iris, it has been most valuable and it has expedited recovery, inasmuch as it has left behind so little cortex to be absorbed; another advantage which it possesses is that of rendering operation possible in very immature cataracts. Elliot (Lancet, Nov. 8, 1902).

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CATARRH, NASAL. See NASAL CAVITIES.

CATARRHAL BRONCHITIS. See BRONCHITIS.

CATARRHAL LARYNGITIS. See LARYNGITIS.

CATARRHAL PNEUMONIA. See PNEUMONIA.

CEREBELLITIS. See ENCEPHALITIS.

CEREBRAL ABSCESS.

Definition.—Cerebral abscess is a focal suppurative encephalitis affecting either the gray or white matter or both. The abscess may be single or there may be several separate foci of suppuration. (See, also, ENCEPHALITIS.)

Symptoms.—The symptoms may be of acute rapid onset or they may develop slowly and insidiously during several weeks or even months. Clinically the symptoms are divisible into those which are general and those which are local or focal, the former being those of general diffused cerebral compression or irritation, the latter representing perversion or interruption of motor, sensory, or special function, varying according to the anatomical site of the abscess. Among the general symptoms which are most common are headache and lassitude, perversion of the intelligence and the emotions, disturbances of sleep and of consciousness, vertigo, vomiting, convulsions, and sometimes optic neuritis. These general symptoms will vary somewhat in degree and character, according to the mode of onset. When the abscess produces symptoms rapidly the headache is more intense; as a rule, there is a more active or decided involvement of intelligence and consciousness, sometimes manifesting itself in acute delirium or in profound somnolence or semicomatose; there may be rigors, with an abrupt and decided rise of temperature, and the whole picture suggests an active meningitis from which, indeed, it may be, and often is, difficult to distinguish it. General convulsions are not uncommon in cases with acute onset. When the symptoms are of slow gradual development they are usually much less intense in degree. The headache is relatively mild; the vertigo may be slight; vomiting may be absent or occur only rarely; instead of somnolence or coma there may be simple apathy, and a state of simple mental confusion with irritability may appear instead of delirium. The temperature in such cases is usually normal or subnormal; occasionally these patients will exhibit periods of remis-

sion attended with a very dangerous semblance of well-being and comfort. Sooner or later the disease becomes aggressive, and evidences of focal disturbance may be observed by which the site of the abscess may be determined. These focal symptoms will vary, as has been stated, in accordance with the function of the brain-area affected by the abscess. There are several methods of approach—short-cuts, so to speak—to a consideration of the focal symptoms. Brain-abscess is apt to develop in certain areas according to the cause with a constancy which is of decided value in localization. When due to an extension from ear disease, for example, the abscess is nearly always found in one of three localities: the temporo-sphenoidal lobes, the cerebellum, or the pons-medulla region. More than half of all cases are located in the temporo-sphenoidal lobes or the cerebellum. If the pus enters through the medium of a secondary phlebitis of the lateral sinus the abscess will quite probably be found in the cerebellum.

If the pus enters the superior petrosal sinus it will be found in the cerebrum and probably in the temporal lobe. When caused by trauma the abscess usually bears some relation in its location to the site of the trauma, though sometimes the pus-formation is at a remote part of the brain from the seat of injury, as, for example, in the occipital lobe, the blow having been received over the frontal region.

Cerebral abscess, when due to necrosis or disease of the bones of the face, is frequently located in the frontal lobes or at the base; when from syphilis or tuberculosis, its site is, as a rule, the motor convexity, the base, or the cerebellum. Pyæmia and other constitutional infections are apt to induce multiple abscesses, which seem rather prone

to develop in the distribution of the middle cerebral artery of the left hemisphere. The data of cerebral localization should be applied in determining the site of the abscess in each instance. The principles of localization in cases of uncomplicated brain-abscess located in active regions apply with unusual constancy, the diffusion of symptoms being less than in tumor, hæmorrhage, or any other focal disease.

It should not be forgotten, however, that brain-abscess occurs occasionally without any apparent focal symptoms at all, and sometimes, indeed, with very few general symptoms, the diagnosis being a post-mortem revelation.

Analysis of 169 cases, including 6 personal. Of this number, 98 were cases of abscess proper, and of these 40 were located in the temporal lobe and 31 in the cerebellum. Localizing symptoms were found, in a large proportion of cases, conspicuous by their absence. As to subnormal temperature, in only 2 cases of these 98 was the temperature below normal. The most constant alteration of temperature was a moderate elevation. Aphasia was present in only 6 of 40 cases, involving the temporal lobe, many of them on the left side. Frank Allport (*Jour. Amer. Med. Assoc.*, Oct. 22 to Dec. 24, '92).

Personal case in which the patient had had no discharge from the ear, the only sign of disease of the mastoid process being dullness on percussion. The cerebral abscess had caused neither somnolence nor fever, but there was a lowered internal temperature and a diminution of hearing on the opposite side from the abscess. On the eighth day incessant hiccough supervened. It was seen on trephining that even very slight packing of the cerebral wound produced the same effect as the compression caused by the pus. The patient completely recovered. H. Eulenstein (*Monat. f. Ohrenheilkunde*, No. 3, '95).

While in many cases an acute abscess of the brain may be diagnosed with some certainty, a chronic cerebral abscess may

exist and yet give no positive indication of its presence. Too often the condition is only discovered by post-mortem examination. The diagnostic indications of a chronic abscess of the brain are few and untrustworthy. Of first importance among such indications is the presence of a sufficient cause, such as middle-ear disease, local injury, or caries of the cranial bones. Not that the exciting cause need be so grave as these; the abscess may follow any of the specific fevers, and, as these occur so very frequently without leaving any such sequelæ, the connection may not be recognized. The signs of a chronic cerebral abscess are few in number,—pyrexia, headache, and optic neuritis,—but none of these can be depended on; pyrexia is often completely absent, and, as Murri points out, in many cases a subnormal temperature is present; the headache, if localized and persistent, and occurring after one of the usual exciting causes, is suggestive, but nothing more; and optic neuritis may equally be a sign of a tumor or meningitis. Other symptoms such as paralyses, though often of use in determining the situation of a lesion, are of no value in deciding as to its nature. If we have in any case a sufficient cause, and the signs already mentioned are well marked, we may be fairly confident that an abscess is present, but we cannot be at all certain. Augusto Murri (*Lancet*, Jan. 5, 12, 26; Feb. 2, '95).

Study of 32 cases, 13 of which were in children under one year of age, 9 of these being under six months and 5 under three months; 3 occurred during the second year, and 5 each in the third, fourth, and sixth years, no case being included in which the patient was five years old or over.

Conclusions: In a large proportion of the cases only general symptoms are present, and these in very great variety. Focal symptoms may be misleading unless they are constant; and even then they may depend upon associated lesions, such as meningitis. Motor symptoms only can be trusted, since the sensory symptoms are difficult or impossible to determine in infants or young children.

L. E. Holt (*Archives of Pediatrics*, Mar., '98).

Report of 2 cases of abscess of the brain due to the pneumococcus, and 7 cases from literature. The first personal case occurred some weeks after recovery from an attack of bronchopneumonia. Vertigo, transitory loss of consciousness, cramps and pain in the right arm, followed by contractures and involuntary movements were first noted. Within a few days there was complete right hemiplegia and rapid death from coma. At the autopsy slight hepatization of the lungs was found, but no bronchiectasis, suppuration, or gangrene. An abscess was found in the left parietal lobe, destroying part of the corona radiata, and extending immediately under the meninges, which were inflamed and suppurating. The pus from the abscess contained a large number of Fraenkel's diplococci, together with chains of streptococci. The second patient complained of joint pains, suffered from delirium, and died within a few days of the onset of illness. Hepatization was found also at the bases of both lungs. A small abscess was found in the corona radiata of the left hemisphere under the lower part of the ascending parietal convolution, the pus of which, as well as the meningeal exudate, contained Fraenkel's diplococcus, together with staphylococci and streptococci. In only one of the 9 cases recorded was the pneumococcus the only organism found. Boinet (*Rev. de Méd.*, Feb. 10, 1901).

Diagnosis.—Ordinarily it is quite apparent in patients suffering from cerebral abscess that some affection of the brain exists. It is by no means so easy always to decide that the symptoms are due to abscess. The diseases which most often confuse the diagnosis are meningitis, tumor, and sinus-phlebitis. The difficulty encountered in differentiating brain-abscess from sinus-phlebitis and meningitis is increased by the fact that the same causes may operate to produce either of them. This is especially true

of trauma and the various infectious diseases and also of disease of the internal ear, though the latter points to abscess rather than meningitis or phlebitis. In all three the temperature is affected, but it is usually above normal and sometimes quite high in meningitis and phlebitis, while it is either below normal or quite irregular in abscess.

Although almost all observers agree that subnormal temperature is the rule in brain-abscess, it must not be depended upon. Case in which the temperature reached to 105° or 106° F., and was so irregular as to suggest pyæmia and thrombosis of the lateral sinus. Again, much stress is laid upon the presence of a cerebellar gait, yet this was often the result of irritation of the auditory nerve or of irritation of the semicircular canals. Optic neuritis is sometimes present, but not often, probably because there was no time for it to develop. M. Allen Starr (*Med. Rec.*, Dec. 11, '97).

Cerebellar abscess may be distinguished from labyrinthine disease by its more violent headache, its persistence, and its location; and by the somnolence which increases from day to day. In abscess of the temporo-sphenoidal or occipital lobes of the cerebrum there are motor affections, paresis, contractures, spasms, but always on the side opposite to that of the lesion or the otitis; and aphasia and hemianopsia are important signs. In glioma, gliosarcoma, tuberculoma, and parasitic tumors of the cerebellum there is a tendency to produce other than local symptoms. Syphilis must always be carefully sought for in the history. Dieulafoy (*Le Progrès Méd.*, June 30, 1900).

In meningitis the onset is usually more acute, the symptoms more diffused, the delirium is more conspicuous, the tendency to rigidity and generalized spasm is more marked; there is photophobia and a state of wide-spread cutaneous hyperæsthesia with accelerated respirations and irregular, high pulse. Focal symptoms are less common in

meningitis except in cases affecting the base, when the number and degree of involvement of cranial nerves is more marked than in cerebral abscess. If the meningitis is localized and circumscribed, I do not believe it is possible to make the differentiation positively. Tenderness of the skull over the site of the disease points to abscess rather than meningitis in such cases.

Traumatic brain-abscesses may be confounded with traumatic meningitis, apoplexy, encephalitis, tumor, epilepsy, and traumatic neuroses. A one-sided traumatic apoplexy or a hæmorrhagic non-purulent encephalitis may, from symptoms alone, easily be taken for abscess.

Suppurative meningitis occurring with an abscess is likely to be overlooked. An abscess of the brain is marked by normal or subnormal temperatures; fever is by no means a necessary symptom. If an attack begins with a rise of temperature, it is probably not due to an abscess of the brain, certainly not to an uncomplicated one. A slow pulse is, perhaps, the most reliable single symptom.

Patients suffering from ear troubles often become hysterical, and a hasty diagnosis of hysteria, even if the typical symptoms are present, may falsely be made in cerebral abscess of the otitic origin. Oppenheim (*Fortschritte der Med.*, Nov. 15, '96).

Case of cerebral abscess in a child 3 months old. First symptoms were of intestinal irritation. Later developed a swelling in the region of the anterior fontanelle. Temperature was 104.5° F. The elevated tumor fluctuated slightly, but distinctly, on pressure, and was of an erythematous cast. There was no ear disease, and child was perfectly healthy. Upon puncturing the dura, it was tough and resisting; cutting forward for about an inch all was well. The longitudinal sinus was punctured, and packing had to be employed and further operation postponed. Packing was removed at end of forty-eight hours. Hæmorrhage had ceased. Packing was again replaced. On removing packing next day it was saturated with greenish,

foul discharges, which welled up from the bottom of the wound; about three fluidrachms came out. The cavity was washed out with 1 to 5000 bichloride-of-mercury solution and packed. The wound healed under this treatment, and patient recovered. W. J. Doyle (*N. Y. Med. Jour.*, July 29, '99).

Symptoms of brain-abscess due to middle-ear suppuration based on 195 cases. It occurs most frequently in early middle life. Out of 175 cases in which the sex was stated, 122 were males and only 53 were females. In 181 cases of temporo-sphenoidal abscess 85 occurred in the right hemisphere and 96 in the left. The variations in the temperature show no characteristic feature, normal or subnormal, a slight or even a considerable rise being variously observed, the complications, such as meningitis or sinus-phlebitis, accounting for these. The uncomplicated must be separated from the complicated before positive deductions can be drawn. The temperature variations noted in 170 cases were: Normal, 46; elevated, 106; subnormal, 18. In cases of uncomplicated brain-abscess the temperature is raised in about one-half. Chills are not frequently noted. The most frequent of the cerebral symptoms is headache, which was present in 103 cases. Stiffness of the neck was noted 12 times, and general convulsions 10 times. General headache is valueless as a sign, but localized headache and tenderness are of some diagnostic importance. It seldom declares itself, however; in 28 cases it was on the same side as the abscess, while in 14 other cases tenderness in the temporal region of the same side was complained of. Disturbance in cerebation occurred in more than one-half of the cases. Mental symptoms were rare, and the sensory disturbances ranged from a slight form of slow cerebation to loss of consciousness and coma, which occurred in 74 cases. Even heavy stupor did not adversely influence operative procedure. The pulse was slowed in 73 instances. In 60 cases changes in the fundus were noted.

As to localized cerebral symptoms, aphasia occurred 53 times in a total of

96 abscesses of the left temporo-sphenoidal lobe. Hemianopsia was met with 6 times. Motor disturbances on the opposite side, whether of the nature of paralyses or as unilateral convulsions, were noted in 70 cases. Hammerschlag (*Monats. f. Ohrenh.*, Jan., 1901).

In sinus-phlebitis the swelling back of the ear with tenderness on pressure and a cord-like hardness of the jugular at times will determine the nature of the condition with little difficulty. Within the past year lumbar puncture has found some favor as a means of differentiating abscess from meningitis and sinus-thrombosis. If the fluid withdrawn is clear and does not contain micro-organisms the disease is probably meningitis. Excess of leucocytes also indicates meningitis. The diagnostic value of lumbar puncture is, however, exceedingly problematical as yet, and promises to remain so, in the opinion of the writer, so far as brain-abscess is concerned, for a very indefinite future.

Most of the cerebral complications observed occur in connection with chronic cases of suppurative otitis media. One should be chary, however, about making a diagnosis of brain-abscess in these cases on the first appearance of cerebral symptoms; it is better to watch the case for two or three days before deciding, as not infrequently apparently serious cerebral symptoms gradually disappear as a free discharge from the ear is established.

Above and back of the ear is the region of the brain concerned in the storage of the memories of the sounds of words. If this part of the brain is injured, the person becomes unable to understand what is said to him. Again, everything that we call to mind by our visual sense employs the function of the occipital lobe of the brain: the visual centres. The connection between the hearing-centres in the temporal lobe and the visual centres in the occipital lobe is made by a long tract lying under the cortex of the brain: a distinct association-tract. When this tract is destroyed,

as it often is in abscess of the temporal lobe, if one ask such a person what some object is that is held up before him, he recognizes the object, but cannot call it to mind and name it, because of the destruction of this association-tract. This peculiar lack of association is an important symptom to elicit in cases of suspected abscess of the temporal lobe, yet it is not commonly mentioned in text-books. M. Allen Starr (*Med. Rec.*, Dec. 11, '97).

Conclusions that in children the rapid progress, fever, and a history of injury or otitis generally make a diagnosis from tumor easy. In the slower cases, in which there is little or no fever, valuable assistance may be obtained from lumbar puncture.

From acute meningitis the diagnosis is more difficult, and in the cases in which there are only terminal symptoms the diagnosis is impossible. In the more protracted cases the distinctive points with reference to abscess are the slower and more irregular course and, as a rule, a lower temperature. L. E. Holt (*Archives of Pediatrics*, Mar., '98).

In a case of pyæmia of the sinuses accessory to the brain, or with a history of trauma with rapid loss of flesh and strength, the presence of a high temperature for a period of seventy-two hours, followed by a decline in temperature and an increase in the rapidity of the pulse, with pronounced flexure of the extremities, progressive increase in the dilation of the pupils, a half-unconscious condition with uncontrollable restlessness, peculiar indisposition of the patient to obey requests, the presence of sugar in the urine, slow respirations, tendency when standing to go toward one side, or swinging of the hands always toward one side, and the entire absence of paralysis, comprises a set of symptoms indicative only of abscess within the cerebellum. L. J. Hammond (*Archives of Pediatrics*, June, '99).

Etiology.—Abscess of the brain is always a secondary condition dependent upon the intracranial invasion of micro-organisms from adjacent or remote sources of infection. Any one of the

pus-producing micro-organisms may act as an exciting cause. The affection may occur at any age, but is most frequently observed in adolescence and middle adult life. It is rare in very young children (Holt) and in old age. Males are more often affected than females in proportions varying from 3 to 1 to 5 to 1 according to the observer. By far the most frequent source of infection is purulent disease of the middle or internal ear. More than a third of all cases originate from this source (Pitt). Cerebral abscess is far more common from chronic than from acute suppurative disease of the ear. This fact has been established beyond question by an analytical study of several thousand cases (Jansen).

It was formerly admitted that the development of an otitic abscess necessarily implied a pre-existing chronic suppuration of the ear. To-day, however, it is known, from cases observed during the recent epidemics of influenza, that cerebral abscess may develop after an acute suppuration of the ear. Monnier (*La Presse Méd.*, Nov. 6, '95).

More than one-half of all cases originate from aural disease. The statistics of Jansen, who found, in an aural clinic in Berlin, abscess only in the proportion of 1 case to 2650 cases of acute otitis, and 1 to 400 of chronic suppurative otitis, are misleading. Abscess is twice as frequent in adults as in children. As to Hessler's statement that three-fourths of all fatal cases of otitis present purulent pachymeningitis, it is found that in less than one-fourth of these cases is there any direct communication apparent between the tympanum and the extradural abscess, microbic migration having taken place through microscopic avenues. Taking 119 cases of true encephalic abscess, analysis shows, with reference to localization, 82 in the middle lobe, 24 in the cerebellum, 4 in both cerebrum and cerebellum, 3 in the pons, 2 in the occipital lobe, and 1 each in the frontal lobe and cerebellar peduncle. Cerebellar abscess is more frequent in

adults than in children, in whom the location is almost exclusively in the temporo-sphenoidal lobe. Pique and Ferrier (*Annales des Mal. de l'Oreille du Larynx, du Nez, etc.*, Dec., '92).

Statistics upon cerebral abscess following disease of the ear based on 100 cases personally observed, 91 being examined after death; in 9 the abscess was opened during life. The frequency of such abscesses in the cerebrum is nearly twice as great as in the cerebellum; in children below ten years of age their frequency is three times that of adults, this difference being, perhaps, the greater distance of the tympanum from the cerebellum in children. The liability of males is twice that of females, and the generally admitted fact of the disease being more common on the right than on the left side is borne out by statistics.

As regards the extension to the brain from the diseased temporal bone, (1) the cerebral abscess most often occurs where the dura is implicated, in cases of disease of the petrous, or mastoid; (2) the dura and brain-substance between the diseased bone and the abscess are generally diseased; in only 6 out of 90 cases was the intermediate brain-substance normal. More careful observation may show more cases of direct extension of the suppuration from the diseased bone than is now thought to be the case. Otto Korner (*Archiv f. Ohrenheilkunde*, vol. xxix, '90).

Next most common cause of brain-abscess is trauma of the face or skull. Practically all cases occurring in very young children are due to one of these two causes.

Study of 32 cases, 13 of which were in children under one year of age, 9 of these being under six months and 5 under three months; 3 occurred during the second year, and 5 each in the third, fourth, and sixth years, no case being included in which the patient was five years old or over.

Conclusions: 1. Abscess of the brain in children under five years is rare.

2. The principal causes are otitis and traumatism.

3. It rarely follows acute otitis, but

most often neglected cases, and is usually secondary to disease of the petrous bone.

4. In the cases occurring in infancy without evident cause, the source of infection is probably the ears, even though there is no discharge.

5. The development of abscess after injury to the head without fracture of the skull is extremely rare. In nearly all the traumatic cases definite cerebral symptoms shows themselves within the first two weeks after the injury. In cases with falls as remote as several months, there is probably some other cause, such as a latent otitis. L. E. Holt (*Archives of Pediatrics*, Mar., '98).

Among adults surgical diseases of the ethmoid bone, the orbit, the antrum, necrosis of the maxillary bones and sometimes caries of the teeth, disease of the frontal sinus, and pyogenic affections of the nose and throat are occasional sources of intracranial pus-infection. Several cases have occurred as complications in erysipelas of the face or scalp. Suppurative adenitis of the cervical glands is another well-known source of infection. Pus-accumulations anywhere in the system—even in remote localities, as the liver, the lungs, the Fallopian tubes, etc.—may, by circulatory metastasis, be attended with a complicating cerebral abscess.

Sudden death of a soldier who was considered to be in perfect health, the autopsy showing a multiple abscess of the left frontal lobe. The man, at the time of his death, was reclining on a bench, reading a newspaper. A few weeks previously he had received a gunshot flesh-wound of the arm, in an engagement with robbers, which had healed readily, the bone not having been injured. The abscess was evidently secondary to the injury of the arm, though not a single symptom—mental or physical—suggested its presence. Surgeon Turner, U. S. A. (*N. Y. Med. Jour.*, Mar. 14, '91).

The brain may be, and often is, at-

tacked in general pyæmia and septicæmia, and tuberculosis and syphilis affecting the encephalon may present the local conditions of abscess. Various constitutional diseases of infectious origin, among which may be mentioned small-pox, typhus and typhoid fevers, grippe, and cerebrospinal meningitis are occasionally complicated with brain-abscess.

Three cases of abscess in the right cerebral hemisphere, all occupying nearly the same position in the centrum ovale, all attended with left lateral homonymous hemianopsia, with great weakness of the left arm and leg, the loss of power being greater in the leg than in the arm, the face escaping almost entirely, and with sensory impairment on the left side. The infective material in two was probably derived from distant suppuration, and in one from an injury of the scalp although the incomplete post-mortem examination renders this uncertain. J. T. Eskridge (*Med. News*, July 27, '95).

Two cases of metastatic abscess of the brain from primary actinomycosis of the lungs. Both cases were considered clinically to be of tuberculous origin. C. H. Martin (*Jour. of Path. and Bact.*, Nov., '94).

Aphasia during convalescence after evacuation of brain-abscess. Dr. Jack's case corroborates the view of Broca and Trousseau, who first maintained that there is no writing-centre in the sense of a centre in which are stored up the kinesthetic memories of written words and capable of stimulation independently of Broca's convolution. The inability to write in this case was absolutely coincident with the inability to talk. When the auditory centre either failed to recall the memory of the sound of the word, or, if remembered, failed to convey the stimulus properly to the kinesthetic speech-centre, it failed also to communicate it to the centre for the movements of the hand. That the centres and fibres affected were not destroyed is shown by the complete recovery. G. L. Walton (*Boston Med. and Surg. Jour.*, Dec. 26, 1901).

Pathology and Morbid Anatomy.—

Brain-abscess is always secondary to the intracranial invasion of pyogenic micro-organisms. The growth of such abscess is steadily progressive except when, as occurs occasionally, a membranous wall of tissue develops, inclosing the pus and preventing its encroachments upon surrounding structures; when so surrounded, the abscess is said to be of the incapsulated variety. When incapsulation occurs the further progress of the disease is temporarily and sometimes for long periods of time arrested. The danger of rupture is always present, however, such rupture resulting in sudden apoplectiform symptoms with death, the picture simulating a sudden vascular lesion. In its incipency brain-abscess presents the local appearance of what has been termed "acute, red softening." Later the pus changes from a reddish-yellow to a greenish or greenish-yellow color, and is at times quite offensive in odor when exposed. The complications usually found are sinus-phlebitis and thrombosis (lateral and superior petrosal), leptomeningitis, extensive meningo-encephalitis, and purulent pachymeningitis. Leptomeningitis and sinus-thrombosis are especially common in cases due to aural disease.

Charcot and Leyden crystals found in pus from cerebral abscess. These crystals have been found in the expectoration of asthmatics, the fæces of anæmics, from the *Anchylostomum duodenale*, in the semen, in bone-marrow, and in other conditions. So far, they seem to have no constant significance. Campbell (Med. Chronicle, Feb., '94).

The streptothrix found in a case of abscess of the brain characterized during life by epileptiform attacks. This streptothrix developed well in different culture-media, though only completely on potato. In the primary pus and in the potato culture it presented the form

of ramifying filaments with knob-like terminations. It stained well by Gram's method. Inoculated into the guinea-pig it did not prove pathogenic. Inoculation into a rabbit caused diffusion of the parasite in the organism without phenomena of reaction or of pseudotuberculosis. Ch. Féré and Faguet (Le Bull. Méd., Aug. 25, '95).

Infection may spread from the tympanic cavity in four directions: (1) upward through the vault, (2) outward through the external table of the process, (3) downward mainly through the lower wall of the mastoid cells, and (4) backward along the groove of the mastoid sinus. Infection spreads, not only through necrotic perforations, but also along the lymph- and blood-vessels of the osseous canaliculi. An unusual mode is through the groove of the transverse sinus and the foramen lacerum posterius. Quervain (Sem. Méd., Aug. 20, '97).

Case of neglected middle-ear disease in which a large necrotic focus was found immediately beneath the groove for the attachment of the tentorium, midway between the hiatus Fallopii and the aqueductus vestibuli, communicating with a focus in the left side of the cerebellum. Bacteriological and histological examination revealed the staphylococcus pyogenes albus, staphylococcus cereus flavus, and the bacterium vulgare (proteus vulgaris). A. P. Ohlmacher (Cincinnati Lancet-Clinic, Sept. 4, '97).

Prognosis.—Brain-abscess is almost always, if not always, inevitably fatal if treated otherwise than surgically. The duration is variable. The acute cases generally terminate within a week or ten days in death. The slow incapsulated variety may extend over months and even years, the patient dying finally from exhaustion or perhaps suddenly from rupture of the abscess-sac.

Analysis of 169 cases in which pus in some form was present in the brain; only 11 recoveries occurred, all of which were operative cases. In 10 other cases the pus was evacuated, either by opera-

tion or spontaneously. Every case not operated upon died, while more than 50 per cent. of those in which the skull was trephined recovered. This emphasizes forcibly the imperative necessity for operative interference in all cases of cerebral abscess. Frank Allport (*Jour. Amer. Med. Assoc.*, Oct. 22 to Dec. 24, '92).

The prognosis of cerebral abscess due to ear disease after operation is not as good as might be expected, because these abscesses are not infrequently multiple (20 per cent.) and on account of the difficulty in making a correct diagnosis. A number of these abscesses run a latent course. Occasionally the symptoms are few and of a passing character. Again, the patient is sometimes seen in the last stages of the disease, when the abscess has burst through to the surface of the brain or into the ventricles. Even when the patient has been under observation in hospitals diagnostic mistakes are possible. When the abscess is accompanied by other intracranial complications a correct diagnosis may be out of the question. Grunert (*Berl. klin. Woch.*, Dec., '96).

The course of an otitic cerebral abscess is regularly acute or subacute. In many cases pus opens into the ventricles or on the meninges after some days or weeks, and proves fatal. It is not rare, however, that the course is slow and that the purulent formation ceases, and the virulence of the infection may then be so light that a limiting wall will form. If the cerebral tissue surrounding the abscess is in nearly a normal condition, absorption can occur. The membrane limiting the purulent focus may undergo calcareous degeneration. Roepke (*La Prat. Méd.*, June 15, 1900).

Prognosis based on statistics of 195 cases of brain-abscess due to middle-ear disease, 180 of which warrant the following conclusions: Out of 106 cases in which the brain was explored through the squamous temporal, 40, or 37.7 per cent., recovered. Of 64 that were explored through the mastoid region, 31, or 48.4 per cent., recovered. Of 10 cases in which the brain was exposed, both through the tegmen antri and

through the squamous temporal, 8, or 80 per cent., recovered. Hammerschlag (*Monats. f. Ohrenh.*, Jan., 1901).

Examination of the fundus shows that in intracranial suppuration following ear disease neuritis or choked disk is rare, unless a combination of suppurative foci exist. From a prognostic point of view, changes in the papilla are of no value. As a rule, there is a distinct retrogression of the inflammation several days after the pus has been evacuated. But even if it should persist or increase, the outlook is no less favorable. O. Kerner (*Deutsche Arch. f. klin. Med.*, vol. lxxiii, 1902).

Every brain case should be explored where the symptoms are focal regardless of the supposed pathological lesion. H. C. Gordinier (*Amer. Jour. of Insanity*, Jan., 1903).

Treatment.—Every case of brain-abscess should be operated upon and the pus evacuated just as soon as the diagnosis can be made. In no department of brain-surgery have results been so brilliantly successful. In a great majority of cases the abscess is easily accessible and can be readily reached. The surgeon should not wait for coma or grave symptoms of irritation or pressure, but should enter the cranial cavity, at least in an exploratory way, as soon as it seems probable that cerebral symptoms in a given case point to abscess-formation.

In trephining after traumatic brain affection it is advisable to distinguish late and early cerebral abscess. The late abscess apparently does not arise in the contused part itself, but in a healthy one, just like non-traumatic abscesses after traumatic suppuration in the bones and soft parts. These late abscesses generally lie deep, and are covered by normal cerebral cortex. The early abscesses usually arise in the injured area, into which infective material penetrates from without. Fatal meningitis is often associated with immediate suppuration. If

the suppurative process is slower, however, and the wound in the brain small, adhesions of the cerebral membranes take place in the region of the injury, and abscesses may result. These abscesses are, to a certain extent, the result of retention of pus in the nests and sacs of a deep wound, and are generally superficial and cortical. They do not develop before two weeks. Very early onset of paralysis or symptoms of irritation are rather signs of meningitis, while the late appearance of symptoms points rather to abscess. (Nasse.)

Details of sixty-seven mastoid operations. Most of them were done in the usual method of Schwartze, but the later cases, to the number of about a dozen, were done by Stacke's method of dissecting off the auricle and soft tissues of the canal and laying them forward, chiseling away the posterior bony wall and anterior wall of the attic, so as to throw meatus, attic, antrum, and tympanum proper into one open and visible cavity, then replacing the soft parts and transplanting a flap of canal-lining into the antrum. In these methods radical removal of all diseased structures is attempted, yet in such an open manner as to rob the operation of many of its gravest dangers; important structures can be more surely avoided, healing is likely to be greatly expedited, and the recovery should be secured with a condition far less likely to relapse into cholesteatoma or other renewed troubles. Panse (*Therap. Gaz.*, Apr. 15, '92).

In opening the skull for cerebral abscess the surgeon need not be always anxious about replanting the bone removed, considering that in three cases the gaps, without replantation, were soundly filled up,—more so than in some cases in which the replantation had been practiced. In order to drain the septic abscesses replantation had been impracticable, but the result was, nevertheless, a sound restoration of the bony case. Rushton Parker (*Liverpool Medico-Chir. Jour.*, Jan., '95).

At the present time it is possible to

reach, and to deal successfully with, the following conditions: 1. Abscess in the cerebrum, especially in the temporo-sphenoidal lobe. 2. Abscess in the cerebellum. 3. Purulent formations at the base of the skull: (a) extradural abscess; (b) subdural abscess. 4. Infective thrombosis of the sigmoid sinus, even when secondary foci may exist.

In all these conditions it is essential to explore the cavities of the middle ear by removing the outer wall of the antrum. The partitions of the roof and sigmoid groove separating the middle ear from the temporo-sphenoidal lobe above and from the sigmoid sinus behind are the two great pathways by which infective matter effects its entrance into the interior of the cranium.

In operating, the path of invasion should be systematically followed up, and this may be done with safety and with efficiency by means of the rotary burr propelled by a dental engine. Thomas Barr (*Archives of Otology*, vol. xxiv, Nos. 3 and 4).

Case of abscess of the temporo-sphenoidal lobe opened and drained through the osseous auditory meatus.

The advantages of this method of operating are obvious: In the first place, we get good and efficient drainage from below. The drainage-tube can, if necessary, be kept in position for months without any discomfort. It can easily be removed and replaced, and there is no danger of not again finding the abscess-cavity. We can also at the same time efficiently treat and cure the attic and mastoid cells, which in these cases are nearly always affected, and thus prevent any recurrence of the disease. Only one incision and only one operation are necessary. The operation and after-treatment are more difficult and tedious than in the ordinary method of trephining, but the results are certainly more satisfactory. Adolph Bronner (*Brit. Med. Jour.*, Aug. 21, '97).

In children a study of thirty-two cases, no case being included in which the patient was five years old or over, led to the conclusion: that on account of the great amount of shock attending brain-surgery in very young children, an oper-

ation should not be urged unless definite localizing symptoms are present, the principal one being hemiplegia. L. E. Holt (*Archives of Pediatrics*, Mar., '98).

In cerebral operations a large area of the skull should be removed. It both enables us to examine the brain better when exposed, and also, if benefit is to be obtained from relief of cerebral pressure, it surely increases that chance; and also it scarcely increases the danger of the operation. E. D. Fisher (*N. Y. Med. Jour.*, Apr. 16, '98).

Delay in operating until the appearance of unequivocal localizing symptoms, or recourse merely to opening of the mastoid when it may be reasonably assumed that cerebral abscess exists, is a far greater injustice to the patient than his subjection to an exploratory trephining of the cranium. Collins (*Amer. Jour. of Med. Sci.*, Apr. '99).

It is important to determine the nature of the micro-organism producing the abscess at as early a period as possible. A large opening in the skull recommended after first turning down a large scalp-flap. For the drainage of an abscess in the temporo-sphenoidal lobe the trephine opening should be made $\frac{3}{8}$ inch above the suprameatal spine. In operating for a cerebellar abscess the trephine should be placed with its upper edge just below Reid's base-line and its anterior edge touching the posterior border of the mastoid process. In incising the dura mater the opening should be made by a flap rather than by a crucial incision. The use of a long, narrow, straight bistoury recommended for the exploration rather than the use of the exploring needle or cannula, as the incised wound of the brain heals better than the punctured wound. The finger is also to be used for exploration. Irrigation of an abscess of the brain should only be resorted to when there is free exit for the fluid, such as is accomplished by the use of a tube. Tamponing these cavities with gauze is not approved. Recurrence of symptoms, especially in cerebellar abscess, is not an uncommon thing a few days after the opening of a brain-abscess, and it is due either to a reac-

cumulation of the fluid or else to an entirely new formation of pus in another part of the same lobe. C. A. Balance (*Lancet*, May 25, '1901).

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CEREBRAL HÆMORRHAGE.

Definition.—Under this head are classed all cases where there is an effusion of blood due to the rupture of some vessel within the substance of the brain proper or in the pia. This hæmorrhage usually starts in the brain, but may force its way out and become subarachnoidal or ventricular. Except in case of accidents, it rarely makes its way into the subdural space.

The dural system of arteries is quite distinct, and bleeding from this source should be considered separately.

Simple tingeing of fluids about the brain, not coming from any blood-focus, does not constitute a cerebral hæmorrhage in the strict sense.

Varieties.—It is customary to classify these cases according to the part of the brain that is the seat of the hæmorrhage as cortical, subcortical, or of the central ganglia; frontal, or of either lobe, pontile, cerebellar, etc. Besides the above, however, there are several subforms, as:—

INGRAVESCENT.—This is a term applied to large effusions developing slowly,—*i.e.*, for a period of several hours or for a day or two. This form is largely observed in hæmorrhage at the external capsule; the peculiarity is owed, first, to rupture of a large perforating artery that passes up at this point, and, secondly, to the parallel course of the nerve-fibres in this tract whereby they continue to separate as the pressure increases.

SYMMETRICAL.—Here there is a double hæmorrhage, starting from corre-

sponding points of the two hemispheres.

MENINGEAL AND VENTRICULAR.—These forms may either start as such—though rarely—or they may start from vessels in the brain-substance and then rupture through into one or the other of these spaces.

TRAUMATIC.—Due to violence or injury, in contradistinction to the general run of spontaneous cases.

PUNCTATE AND CAPILLARY.—These are sufficiently explained by the terms. Of themselves they are rarely of sufficient moment to be of other than pathological interest.

Symptoms.—**PRODROMATA.**—The so-called premonitory symptoms include headache, dizziness, pallor or flushing of the face, fullness in the head, flickering before the eyes, visual obscuration, poor sleep, tinnitus aurium, thickness of the tongue, numbness or peculiar tinglings of one side of the body, heaviness of extremities, slight mental changes,—as lapses of memory, drowsiness, and irritability,—changed, slowed, or intermittent pulse, etc. These, when occurring in an elderly person, are thought by many physicians to point to an impending hæmorrhage. There is no doubt that such symptoms frequently precede thrombosis. This fact, together with the lack of adequate pathological proof and inability to account for premonitions in hæmorrhage, has caused a disinclination among conservative observers to recognize any connection of the kind. In some cases, however, there may be a preliminary oozing sufficient to produce slight symptoms. Further the evidence of a vasomotor influence suggests that a local paralysis of vessels with sufficient dilatation to irritate the adjacent tracts may precede the actual rupture. This, how-

ever, in a few days ends in a frank attack of apoplexy. In the aged most of these symptoms point rather to thrombosis; but in earlier years they may give warning of incipient hæmorrhage.

Constipation is common in the prodromal stage, but is too usual a matter to have any diagnostic significance. Turgidity of the vessels of the head, severe pain in the head, convulsive twitchings of an extremity (Jacksonian), unilateral chorea, etc., are rare, and belong to the initial stage of apoplexy—or, of course, more often its later stages.

Onset.—The symptoms that may mark the onset of the attack include the various prodromata just mentioned; also faintness or general prostration, convulsive movements, aphasia, paralysis, stupor and even unconsciousness, free perspiration; slow, tense pulse, etc.

The regularity and the sequence with which these appear are very variable. In fulminant attacks the severest symptoms may promptly develop, and even death itself be not long delayed. Sudden death may occur if the trouble is in the pons. Oftener there is a gradual increase, both in the number and the severity of the manifestations, for some little time: one, two, three, or more hours.

Headache.—Very often there is no special complaint of pain in the head, and again headache has been such an habitual thing with the patient that little importance can be attached to it. Nephritic complications, when present, tend also to rob this symptom of value.

In many cases, however, there is headache, severe, deep, and general in character, less often localized. It becomes more pronounced as the effusion increases in volume, and, even when the consciousness has become more or less obscured, the sufferer may persist in put-

ting a hand to the head, evidently because some degree of pain or distress is still perceived. When, therefore, we meet a headache unusual to the patient, excruciating in character, not otherwise explicable, and associated with suggestive phenomena, it acquires some value as a symptom.

A low, occipital pain is common in cases of cerebellar apoplexy; but as it may be due to other causes its only significance comes from association.

Vomiting.—This is a common symptom and one of much clinical importance, its value, however, depending much on the certainty with which uræmia can be excluded. Nausea may, of course, attend dizziness, faintness, or thrombosis; but actual vomiting, aside from uræmia (especially if the person is reclining), argues, in a suspicious case, for hæmorrhage. This applies to the increasing period of the effusion.

[It has been claimed to be especially frequent in cerebellar hæmorrhage, but, as stated, it is common in all forms. W. BROWNING.]

Where the latter is at all voluminous, in almost any part of the brain we see vomiting, often severe and even somewhat prolonged. Its occurrence depends upon the volume of the effusion, the speed with which it is poured out, and to some extent upon its location. In the slower, or ingravescient, forms, even though they finally reach a large size, there is less tendency to emesis. It is where we find other evidence of an apoplectic seizure that this symptom acquires value; then it also assists materially in differentiating the nature of the brain-process.

Nearly always some other plausible explanation is proffered: the person has just eaten overheartily, been lying in a cramped position, had an hypodermic.

taken medicine that upset the stomach, or been suffering from gastric catarrh. The diagnostician must, of course, be able to discount such suggestions.

Yawning and Sighing.—These are very frequent and striking symptoms in hæmorrhage, and are often more marked if the patient is in a sitting position. There is a slight parallelism between them and the vomiting. But as they are also common in cases of thrombosis and may occur in embolism while there is a badly damaged heart, they have only a limited diagnostic value. In cases of hæmorrhage these manifestations suggest that the focus has already reached a sufficient size to produce some degree of brain-anæmia.

Coma and Other Disturbances of Consciousness.—These are of great importance for both the positive and the differential diagnosis. But at the same time they are matters most difficult to describe or define with exactness and in accordance with the facts.

Coma is a state of profound unconsciousness not due to sleep, syncope, or drugs. But in practice we meet all kinds and degrees of disturbance of consciousness. The eyes may be open and staring, yet the person fail to make any responses to our interrogations and evidently fail to have any understanding of language or surroundings. More often there is a condition of stupor that admits of but partial and temporary recognition. We can then conveniently distinguish coma, stupor (a partial coma: "semicomatose"), and dazed conditions.

The duration of these states is next in importance. They may be of such transitory nature as to pass unnoticed, or they may last several hours or days, the lighter degrees being, of course, as a rule, of shorter duration. The time in the attack when coma supervenes is also

to be noted; if at the start it may be partly a direct shock-effect; if later and more gradual it indicates that the effusion has reached a large volume.

The size of the output requisite to produce this symptom varies much with its location. A small clot in the pons, for instance, will produce a much deeper impression on consciousness than one of far-greater size in the pallium. Wernicke and others have sought to explain this by the smaller size of the vessels, their indirect course, and hence slower leakage in the hemispheres. But this view is negated by several facts, however well it may explain the favorite sites of hæmorrhage.

[A competent medical friend offers the following more scholarly definition: "Coma is a condition of profound unconsciousness, the result of injury, disease, or some form of intoxication." But the sleep of chloral or morphine is not termed coma, while, on the other hand, that of alcoholism often is. Neither is true coma always so profound. In fact, there seems to be a considerable latitude in the use of this term.

Perhaps the above definition might be modified as follows: Coma is a state of unconsciousness due to some other cause than sleep or syncope. The effects of intoxications, soporifics, or anæsthetics should only be called coma when the person can no longer be roused to consciousness. W. BROWNING.]

The comparison of a large number of these cases shows that involvement of the sensory tracts has little or no influence on consciousness, while other cases with equal-sized foci involving certain parts of the motor path show, as a rule, very marked impairment of consciousness. From a psychological stand-point this seemingly anomalous fact agrees with conclusions based on other evidence. But it is cited here to prove that much depends on the part involved as to the effect on consciousness.

A close analogy can also be drawn with cases of embolism. The writer has shown that embolism involving only parts above the basal ganglia does not cause coma. Inasmuch as in many of these cases a large patch of brain-tissue is involved, and as, further, the suddenness of the attack must be equal, whatever the part involved, it follows that here again much must depend on the particular structures included, for smaller infarctions, if only they involve the ganglia, often do bring on coma.

It can consequently be stated that, whatever accessory influences there may be, there are but two important governing factors in the development of coma: the size of the hæmorrhage and the particular part of the brain implicated. These deserve a little further consideration.

As to the amount of hæmorrhage that will of itself cause coma, experiments on animals by Pagenstecher, von Schulten, and others have led to the conclusion that in the human being one and a half to two ounces is about the extent of limitation of the brain-space that can be borne without interruption of psychological functions. (More can be tolerated in a diffuse effusion like a meningeal hæmorrhage than in a confined focus.) The exact amount thrown out in a case of apoplexy is rarely, if ever, known, since some of the fluid is promptly absorbed or scattered, and, independent of that, it is impossible to more than estimate the volume of these irregular foci. So far as such rough estimation goes, it corresponds fairly with the experimental results. This applies to cases in the hemispheres (pallium). When the size of an effusion is stated to be that of a hen's egg, it may be considered to equal two ounces of fluid. Hence, hæmorrhage of that bulk should be, and in

practice is found to be, on the borderline. It may be expected to at least produce stupor and frequently some coma. When of greater volume, coma very generally results. In the basal ganglia, however, a much smaller amount may suffice.

The principle here is that the effusion, by its volume, exerts such a general pressure on the whole cortex as to obtund consciousness. Of the sufficiency of this factor there is no question. It may act by producing an anæmia or by more direct mechanical effect. Further, a compression, before ineffective, may become sufficient if the arterial pressure sinks.

As to the susceptibility of different parts, injury below the oblongata (*i.e.*, in the cord) does not cause coma. The syncope of shock or even sudden death may result, but not real coma. And it is uncertain whether hæmorrhage of the oblongata has much tendency to produce coma; most such cases are small and any stupor is masked by respiratory and other phenomena. In the old case of Fabre (quoted by Gintrac and others) some loss of consciousness attended a small hæmorrhage of the left pyramidal body. But in several other cases of small effusion in other parts of the oblongata no distinctly comatose condition has developed.

At the other brain-pole—*i.e.*, corticad of the central ganglia—we have already seen that coma is essentially a consequence of general brain-compression. In this major portion of the encephalon there is little difference between the various parts. Apparently the occipital lobe tolerates infringement better than the frontal and parietal lobes; but there is no decisive difference.

Regarding the cerebellum, the general opinion agrees with the evidence that

uncomplicated hæmorrhage when moderate in amount does not invoke coma. But in these rather rare cases either rupture occurs or, if much size is attained, there is so much pressure on subjacent structures as to obscure the bearing of the case.

There still remains the region of the central ganglia, the cerebral crura, and the pons. Hæmorrhage of the caudate nucleus is prone to bring on coma. That in the lenticular nuclei and in the thalami is somewhat less apt to do so. When in a cerebral crus, there is commonly some coma or, at least, stupor, though these hæmorrhages are rarely voluminous. Those of the pons are most inclined to cause coma, though usually small unless they have already ruptured. A comparison of this last group of cases (involving the brain-stem) brings out forcibly one fact already referred to,—*viz.*: that hæmorrhages in the sensory path show but little tendency to cause coma, while those in the motor path have a marked tendency in that direction. This fact stands out quite as clearly when they are compared by volume. It is, of course, not certain whether this applies specially to the motor tract or to other and less understood tracts closely associated with them; it may be fibres to the so-called somæsthetic area. So far as this coma-zone has been noticed in the past, it has been thought to depend upon the fact that here were grouped fibres passing to, and thus influencing all parts of, the brain.

Secondary Factors in the Causation of Coma.—There are, of course, various other influences that affect this result. The person's susceptibility is one; carbonic-acid poisoning due to superficial respiration is another. But most important of these is the rapidity with which the effusion occurs. On the ex-

perimental side it is well known that the effect on consciousness depends somewhat on the rapidity with which the compression is produced. But it is rare in clinical work to meet cases where a hæmorrhage has taken place with any such rapidity as in the average experiment. As Liddel long ago pointed out, considerable time is taken up before the bleeding stops. We also know that in the slow, ingravescent form, though a day or two elapse in the process, coma just as certainly supervenes when the volume of the focus becomes adequate.

The disappearance of coma is attributed to a re-establishment of the circulatory balance, to reduction of pressure from lessened cerebrospinal fluid, and perhaps a gradual tolerance to the focus. The shock-effect passes off, and some of the fluid of the focus is absorbed.

Aphasia.—This symptom, of itself and without corroborative manifestation, is rarely indicative of cerebral hæmorrhage. A considerable majority of all cases of aphasia are due to other causes (see article on APHASIA, vol. i). These are mostly transient forms lasting from a few hours to a few days and embracing all degrees of speech-impairment up to its complete loss. They are occasioned by gout, uræmia, and less frequently other toxic conditions. Possibly the standard writers do not take sufficient notice of these transient forms. Even of the more lasting cases a certain number will be due to thrombosis, embolism, etc.

Only in a part of the cases of cerebral hæmorrhage do aphasic symptoms appear. To produce these the speech-tract must either be directly injured by the effusion or indirectly implicated by pressure. This, of course, only occurs when, in right-handed persons, the lesion

is on the left hemisphere, and in left-handed in the right hemisphere. Apparent exceptions to this rule occur as in a recent case (of embolism) where an originally-left-handed youth had so trained himself that he passed for a right-handed person.

All degrees and forms of aphasia occur in association with hæmorrhagic apoplexy. Where it is due to implication and not to direct involvement of the speech-centre or tract, then recovery from this symptom may occur, the time required and the extent of recovery being dependent on the circumstances of the case. By speech-centre we, of course, mean not only the motor centre in Broca's convolution, but also the hearing-centre and other associated parts. Inasmuch as all forms of aphasia and paraphasia are involved, it is not practicable to enter on a discussion of them here.

Convulsions, Twitchings, etc.—Rarely a few spasmodic twitches occur during the onset-period in the territory where paralysis is developing. These may not be noticed unless in the face. It is not certain that they point to a cortical focus.

Quite distinct from these are the unilateral clonic convulsions (Jacksonian type) that occur in the rare cases of effusion about the cortical motor area. Such cases are far oftener of traumatic than of spontaneous origin.

Of course, uræmic convulsions may bring on or accompany an apoplectic seizure, though this is unusual. Otherwise general convulsions in this condition point strongly to ventricular hæmorrhage or to rupture into the lateral ventricles.

[They also are not rare in thrombosis, and in both meningeal and frontal hæmorrhages. W. BROWNING.]

Even in case of such rupture, however, convulsions do not always follow; nor does slight oozing, as in many cases of impending rupture, have this effect. When such convulsions do occur, they may be of the severest character that we ever witness. In any case, such complications give a very bad outlook, for ventricular rupture is only more certainly and rapidly fatal than uræmia. Rigidity of the paralyzed or even both sides is also frequent in ventricular rupture.

Paralysis ; Respiratory Paresis.—This is one of the commonest as well as most striking and characteristic symptoms, although not a necessary accompaniment. It may affect either motion or sensation or both.

The time of the attack at which it develops depends on the location and the rapidity of development of the effusion. Usually it appears with the onset of the seizure, though at first frequently but a mild degree of paresis; in such a case we can conclude that, as yet, the motor path is only suffering from pressure. In occasional cases the paralysis is not manifest until later or becomes pronounced only in the reaction-stage; but it is then difficult to distinguish from an increasing effusion.

Motor involvement constitutes the most marked and important manifestation of average cases, and when present may range all the way from the slightest degree of weakness up to complete flaccidity. While any of the voluntary muscles may suffer, certain prevalent types can be made out. Monoplegias and more limited paralyses, running as such from the start, occur in some of the rare cases of hæmorrhage cortical of the internal capsule. When this is in the occipital, frontal, or temporal lobes, there may be no definite paralysis unless the focus

becomes so large that the transmitted pressure affects the motor neurons. But, as the great majority occur in the basal ganglia or pons, the hemiplegic type is by far the most common. Of this there are two distinct forms: the one of simple hemiplegia, where all the affected parts are on one side (arm, leg, and face, all or in part), and the other of crossed hemiplegia, where an arm-and-leg paralysis on one side is associated with some involvement of the cranial motor tracts on the other side. This latter form is typical of localization in the pons, because of the fact that the cranial tracts have already decussated, while the first form is that due to the common site in the basal ganglia. In the very rare cases of bleeding in a cerebral crus, there may be a special form of crossed paralysis: involvement of the arm and leg on the side opposite the lesion and oculomotor paralysis on the same side, due to the intimate relationship of this nerve with the crus.

There is some basis for the view that lesions of the thalamus *may* present a special characteristic. This consists of loss of emotional or pantomimic movements, while the volitional motions are still preserved. This applies specially to the cranial distribution. If, on the contrary, the cranial paralysis is due to lesions more anterior at the same level or higher up there may be a preservation of the so-called mimic, with a loss of voluntary, movement. In practice, hæmorrhages of this region are usually so massive that both grades of motion are equally lost.

It is possible that something of the kind also holds for the extremities, since we sometimes see cases of hemiplegia where, in sleep, the patient is able to lift a hand to the head. Here may also be classed the so-called methemiplegic

movements; these are such as occur in a paralyzed part in association with voluntary movements in the corresponding well part.

In ordinary hemiplegia we find the arm and leg motionless or nearly so, a little motion possibly remaining in the fingers or toes. The arm lies helpless by the side or across the chest. The patient, if requested to move it, reaches over with the other hand. The leg stays in almost any position in which it is placed. In the complete form it is impossible for the patient to turn in bed or to rise at all from the recumbent position. In coma the paralysis may be presumed from the drawn face, expiratory puffing of one cheek, and the heavier, passive drop of the affected arm when lifted and let go.

As a rule, the leg improves faster than the arm, perhaps, as claimed, because the arm-tract is apt to be more involved than the leg, or, perhaps, because the leg-movements (as in walking) are more automatic in character. It is considered an unfavorable omen when, on the contrary, the arm improves faster than the leg. The hypoglossal and facial tracts are more apt to escape direct implication, and the upper facial quite regularly escapes (a point of distinction from like hysterical paralysis).

Sensory loss is also a common though less frequent and lasting accompaniment than motor. In many cases it is so transient that in a few days little trace of it remains. Its occurrence depends on interference with the sensory neurons. Their most exposed point is at the *carrefour sensitif* (posterior border of the internal capsule), where the sensory tracts are more closely grouped than elsewhere in their course. This point is also about opposite the commoner sites of hæmorrhage, though a little to

one side, which harmonizes with the fact that permanent loss of sensation is the exception. The most-marked features of this type are loss of common sensation in the opposite half of the body and homonymous hemianopsia (blindness of opposite half of visual field of each eye). Hearing may also be interfered with and sometimes taste and smell, the latter two only on the opposite side. In hæmorrhages involving either the hearing-centre in the first temporal gyre, the visual centre in the cuneus, the other sensory centres, or the paths connecting these with parts below, there will be a correspondingly-limited loss of sensation. In pons lesions the special senses escape, unless occasionally those of hearing or equilibrium. At the same time the tracts for general sensation to the other side of the body may suffer. In cases where there is more lasting anæsthesia it involves deep parts and mucous membranes as well as the surface.

Eye-symptoms.—Pupillary changes have but little value here for purposes of localization. They do, however, serve one important and usually overlooked purpose: the presence of anisocoria (inequality of the pupils) is valuable objective evidence of the existence of some real lesion, and has a bearing on differential diagnosis. Of course, this presupposes the existence of corroborative symptoms and the recent acquisition of the inequality. The possibility of latent anisocoria should be excluded by determining whether the condition persists on full illumination of the two eyes; if, on so testing, the pupils become equal, the inequality can be put down as probably an affair of long-standing or spinal in origin.

Inequality of the pupils may occur in large effusions that by pressure weaken

the oculomotor on that side and thus allow that pupil to dilate. It is consequently not rare in cases involving the frontal lobe or basal portions of the cerebrum. In pons troubles anisocoria is common, though both pupils may be large or small according to the degree of third-nerve involvement. In meningeal forms the pupils are often affected, though there is no rule here for our guidance.

Conjugate deviation of the eyes very often points to a lesion on the same side, but this is not an invariable rule.

Diplopia or more distinct evidence of paralysis of external ocular muscles is unusual except in comatose conditions. Its interpretation depends on the individual case.

Ophthalmoscopical changes are not sufficiently marked in the early stages to be of any value, nor are they often much more so in the later. After development of the full apoplectic state there may be some choking of the retinal veins, especially on the side of the lesion. Miliary aneurisms have been observed in the retina, but are quite unusual. Hæmorrhages of the retina may indicate nephritis; but only to that extent suggest the cause of any cerebral condition.

Bowels.—Constipation frequently precedes or accompanies the attack. Or, on the contrary, where there is deep unconsciousness or prolonged stupor, and especially if drastic purgatives are given, involuntary discharges may occur. Their chief importance lies in the necessity, then, of scrupulous care lest eczema and bed-sores develop, and in the commentary they offer on the state of consciousness or the possibility of dementia.

Urine.—At the onset the urine is usually acid. Transient glycosuria is a possible accompaniment of hæmorrhage in any part of the brain. The sugar usu-

ally disappears from the urine in from a few hours to a couple of days. Presumably it originates from shock to the so-called sugar-centre. When this spot in the floor of the fourth ventricle is directly involved, the sugar may persist longer, though it usually subsides, even then, in a week or two.

As a part of the same manifestation there may be a polyuria simply, that is then even more fleeting in character.

Albuminuria is a frequent and more serious accompaniment. Like the preceding symptoms, it may be but transient in character; but its presence is always a cause for anxiety. Many cases of apoplexy are due to Bright's disease, and an examination of the urine, therefore, should be a routine procedure in all cases.

Hemichorea.—This is of rare occurrence. It may either precede the attack (prehemiplegic chorea), though this is unusual where hæmorrhage is the cause, or it may develop during the recovery stage (posthemiplegic). It is thought to be due to irritation either of the motor tracts or else of some band of fibres closely associated with these. It is a symptom of irritation rather than of destruction, and hence is never present where the paralysis is complete. If an inaugural symptom, then it disappears as the paralysis deepens; otherwise it comes on as the paralysis begins to mend, and in turn also disappears as the paralysis wears away. Hence its appearance in convalescence is a good omen, however annoying to the patient. It is not a symptom of the attack itself.

This affection involves strictly one side of the body only. It may take in principally an arm or the lower extremity, but usually involves both more or less. In degree it varies much according to the stage; but is often severe and con-

tinuous in character. The type of movements is hardly different from that of ordinary chorea of childhood.

Tendon-reflexes.—At the onset and during the period of development no great changes in the reflexes can be made out, unless diminution. But so soon as the effusion seriously interferes with the motor path and even more after the subsidence of shock the tendon-reflexes of the paralyzed parts show a decided increase; this may apply both to the force of the reflex and to the extent of area from which it is elicitable. In gross lesions the pathological jerks like ankle-clonus and wrist-clonus may also be demonstrable, either immediately and temporarily, or later on after descending degeneration. It is necessary to compare the two sides to settle the relevancy of the symptom. Even then there are cases in which both knee-jerks are increased from unilateral lesion, in proportion, perhaps, to an incomplete decussation of the pyramidal tracts, as is further shown by the somewhat bilateral paralysis of the lower extremities. As a rule, however, we find a purely-unilateral exaggeration of the tendon-reflexes.

OTHER SYMPTOMS.—Those pertaining to the period of the seizure are almost described by their enumeration.

A slightly-subnormal temperature (one to two degrees) may frequently be found for an hour or two after the onset. Later an increase of temperature is not unusual. It amounts to but a few degrees at most and is transient in character, lasting only a few hours, as a rule. These variations in temperature are somewhat commensurate with the severity of the seizure. From the experiments of Ott and others it is known that there are so-called heat-centres as far corticad as the caudate nucleus, and it

is to disturbance of these that the hyperthermia is doubtless due. It is claimed for pons hæmorrhage that the temperature may rise from the start.

Trouble in swallowing (dysphagia) may be simply an expression of the general weakness, though at times it seems to partake of the nature of a central paralysis. It necessitates extra care lest food slip down the trachea.

The respiration is often affected. Stertorous breathing is an attendant on the deeply-comatose state. In the subsequent weak condition of the severe cases Cheyne-Stokes respiration may appear at any time and is especially prone to do so in the hours of deep sleep. It may also occur in the primary coma.

The subsequent mental condition often shows impairment of intelligence, psychical functions, memory, and mental grasp. These incline to be the greater, the severer the attack. Laughing or crying on inadequate provocation, an anxious haste in carrying out anything planned, and many other aberrations might be cited.

PERIPHERAL TROUBLES.—*Contractures.*—These may develop some weeks after the attack, and are usually spastic and functional rather than organic. They are associated with great increase of the tendon-reflexes. By a slow, steady counter-pressure complete extension can be effected, but the part quickly becomes flexed again on relaxation. This condition means little else than that the corresponding fibres of the pyramidal tract are involved. Separate from this is the early rigidity due to stimulation of the motor tracts by the irritative lesion.

Edema.—This condition of the paralyzed part is not of very frequent occurrence. It has been thought to be due to degeneration of the pyramidal

tract, but it sometimes develops so early after the apoplectic seizure that the neural change could hardly have taken place. The amount of swelling may be little or much, and changes readily with the position of the patient. It collects at the most dependent part of the extremity.

Neuritis.—Occasionally a degenerative neuritis develops in the affected area. Considerable pain may be associated with it, though this must not be confused with the muscular tenderness that often follows directly on the paralysis. The reason for the occurrence of this form of neuritis is not well understood. Possibly it is an outside process grafted on such nerve-fibres as have least resistance.

Decubitus.—This is not, as a rule, as liable to occur or as resistant as in disorders directly involving the peripheral neurons. Still, from the inability of the paralyzed patient to relieve pressure on prominent parts, from the maceration by the discharges when not scrupulously cared for, and from the frequently impaired sensation, it is very easy for bed-sores to develop.

Trophic changes are supposed to be due to trouble with the innervation from the peripheral neurons; but Nothnagel and others have adduced some facts indicative of trophic influence from certain parts of the brain. Vasomotor disturbances, lowered arterial tension, etc., are observed on the paralyzed side.

Differential Diagnosis.—This has to be made between hæmorrhage and the following conditions: Embolism, thrombosis (including its precedent conditions, such as syphilitic arteritis), pseudoseizures, certain toxæmias (as uræmia, gout, alcoholism, etc.), simple fainting, hysteria, and sudden death from various causes.

The practice of uniting nearly all of these under the one head of apoplexy is, unfortunately, too common. While our diagnostic methods are not sufficient for all cases, the following principles will usually suffice to differentiate. Good medical judgment is here a strict necessity. To know our patients, their past histories, and any chronic disorders from which they may be suffering is of great advantage.

EMBOLISM.—Against embolism speak: the absence of any distinct mitral or aortic lesion, the presence of headache or other prodromal manifestation; deep coma, especially late development; vomiting, pronounced anisocoria, and advanced age.

THROMBOSIS.—Against thrombosis speak: youth unless the patient be a syphilitic, coincident or early rise of bodily temperature, early and deep coma, vomiting, great inequality of the pupils, high barometric pressure at time of onset, beginning of attack when the person is under effort or excitement, a pulse of high tension, the absence of prodromata, and the existence of vigorous general health.

PSEUDOSEIZURES.—The question of a pseudo-attack can only arise where the subject is also suffering from either progressive dementia, tabes, disseminated sclerosis, or possibly the results of alcoholism.

The other possibilities can be excluded more readily and on general lines.

Case of cortical hæmorrhage with rupture into the lateral ventricle in which two symptoms were at variance with authoritative statements: 1. Difference of temperature between two axillæ; paralyzed side 1.2° lower. 2. Conjugate deviation of the head and eyes toward the right (the paralyzed) side. Rigidity of arm on paralyzed side pres-

ent. H. A. Royster (N. Y. Med. Record, Dec. 7, '95).

The absence of glycosuria in a doubtful case is inconclusive, but its presence points to a cerebral hæmorrhage, doubtless accompanied by invasion of the ventricles. M. A. Robin and W. G. Kuss (*La Méd. Mod.*, No. 61, p. 481, '97).

Following conclusions reached from study of eight cases of cerebral hæmorrhage, embolism, and thrombosis: 1. In cases of hemiplegia from cerebral hæmorrhage which terminate fatally, large hæmorrhages are not frequently found in the retina on the same side as the brain-lesion, while no hæmorrhages are present in the opposite retina. 2. In cerebral embolism the same retinal condition is occasionally met with; also in cerebral embolism occasionally the retinal vessels are slightly dilated on the side of the brain-lesion. 3. In thrombosis of the middle cerebral artery, when the thrombosis extends down into the internal carotid, the vessels of the retina on the side of the brain-lesion may be markedly dilated and tortuous, while the retinal vessels of the other eye are normal. R. T. Williamson (*Brit. Med. Jour.* June 11, '98).

The term apoplexy is still loosely used even by the best writers. Cerebral arterial disease is almost never due to vascular involvement of the brain, excepting when the cardiac or respiratory centers are involved. Sudden death is almost always due to heart disease. A diagnosis between cerebral hæmorrhage and thrombosis is desirable, but impossible. In hæmorrhage the treatment should be directed to lower vascular pressure, while in thrombosis exactly the opposite line of procedure should be employed. H. N. Moyer (*Amer. Medicine*, May 25, 1901).

Etiology.—The immediate cause of the hæmorrhage is, of course, the rupture of some vessel, usually an artery, but occasionally a vein. Back of these vascular changes we come to the real causes that interest the practitioner. And here there is a broad distinction between senile conditions and those other factors

that may be active at any period of life. In the young a considerable proportion of the rare cases is due to the rupture of some single large aneurism in the vessels of the pia; as to their etiology, little is known. Except for these and before the advent of senility we find either nephritis, syphilis, local softening, traumatism, abnormal blood-conditions, or possibly certain nervous influences as the predominant causes.

Miliary aneurisms have much less to do with its causation than has previously been held, and, apart from mechanical causes, such as trauma, etc., hæmorrhage of the brain is most frequently due to disease of the vessels that causes a loss of elasticity in their walls. Typical miliary aneurisms are rare, but atheromatous and syphilitic changes of the vascular walls play a very extensive rôle. Mechanical causes are more common than is commonly held to be the case in producing hæmorrhage, without any real arterial disease sufficient of itself to produce it. L. Stein (*Deut. Zeit. f. Nervenhe.*, vol. vii, p. 313, '95).

Case in an infant 5 days old. Notwithstanding absence of marked cerebral symptoms, extensive hæmorrhage into the brain, no convulsions or even unconsciousness were present. T. M. Rotch and A. H. Wentworth (*Boston Med. and Surg. Jour.*, Aug. 15, '95).

Case of mixed hæmorrhage and thrombosis secondary to mitral disease in a child 7 years old. Fox (*London Lancet*, Jan. 27, '94).

While cerebral hæmorrhages often follow the development of small aneurisms, and embolic lodging in arteries may cause the development of aneurisms, aneurism with subsequent cerebral hæmorrhage as the result of verrucose endocarditis may also occur. In 3 cases—the patients being 32, 45, and 50 years of age, respectively—fatal cerebral hæmorrhage could be ascribed to the lodging of a septic embolus, a fresh endocarditis ingrafted on old disease being found, the arteries and the kidneys being healthy. Four other illustrative

cases mentioned. M. Simmonds (Deut. med. Woch., May 30, 1901).

In traumatic cases the violence is a sufficient explanation. As a rule, the hæmorrhage results promptly. But there are now several cases on record showing that several hours or days, even a week or more, may intervene. These are mostly meningeal forms, yet it is certain that some are intracerebral. It is these cases of delayed apoplexy that serve to associate the traumatic with the other varieties.

Case of a child of 5, who fell, striking on her head. She became somnolent, answered questions correctly, but hesitatingly; perfect sensation and muscular co-ordination. Discoloration of all the palpebral and ocular tissues, with sufficient œdema to completely close the right eye; left pupil responded readily to light. Trephining revealed a clot three-sixteenths of an inch in thickness and one inch in diameter, which had formed between the dura mater and the parietal bone. This was evacuated and drained and the child recovered. Ruth (Jour. Amer. Med. Assoc., Feb. 6, '92).

College-student, aged 19, struck in a friendly boxing-bout upon the left jaw, large gloves being used. Death on the sixth day. No external marks of violence. Left lateral sinus found ruptured. No pathological changes present in the vessel-walls. Walton (Boston Med. and Surg. Jour., Mar. 1, '94).

Nephritis is one of the most certain causes. The arteriosclerosis that develops may later degenerate, allowing the vascular tunics to give way. In any case the heightened blood-pressure and perhaps the circulating toxins so weaken the arterial wall that under some sudden stress it breaks.

Syphilitic alterations of the vascular parietes seem at times to be the immediate cause of their rupture; though this claim needs a better basis than the fact that the patient is a specific or that antisyphilitic remedies produce a good

effect. Much more certain are the cases where the break results indirectly. In them a former specific arteritis, that may long since have run its course, has left behind it a cicatricial and hence weakened spot which ever after remains. Like all scar-tissue, this has less resistance and too often in time yields. This point has been strongly urged by Gowers. There are also evidently other cases in which softening of this origin makes the intermediary link to vascular rupture. In neither of these latter forms can specific treatment well have any value; they differ only etiologically from the general run.

Of 100 non-fatal personal cases 36 were due to syphilis; they occurred in early life and were often multiple in character. Cerebral hæmorrhages were rarely repeated. Many cases showed changed vital conditions and personal habits. C. L. Dana (N. Y. Med. Jour., Jan. 5, '95).

Local softening. This may be due to traumatism, embolism, septic infection, syphilis, or whatever other cause. The focus is usually not a large one, and not the cause of any definite symptoms. Even if its presence were known, it is hard to see how anything could be done to remedy it or ward off this particular sequel. The prevention of the softening must depend on the general management of those affections that lead to it.

Abnormal constitutional blood-conditions, such as scorbutus, purpura, pernicious anæmia, leucocythæmia, and severe infections with hæmorrhagic diathesis may act as efficient weakeners of the vessel-parietes. Hæmophilia is not known as a cause, however much it might darken a case.

Nervous influences. The probability of these as a factor was suggested by the writer to explain certain occasional peculiarities, as the onset during sleep,

when the blood-pressure is lowest, the absence of aneurisms as a source of hæmorrhage in many cases, the asserted occurrence of prodromata at times, and especially the occurrence of symmetrical hæmorrhages. It is to the vasomotor control of these parts that such action must be assigned. This principle rests on the close bilateral association of the brain-hemispheres, and presumes that any general influence—as from the abdominal or thoracic viscera, reaching some centre or part of one hemisphere—affects at the same time or in immediate sequence its opposite in like manner. Possibly by allowing a dilatation of the arteries to the respective parts a strain is exerted on the vessels secondary thereto, and thus weak points give way. Whether this cause can of itself be sufficient or whether it at most is only an immediate cause cannot be stated.

Two cases of apoplexy which were considered as hysterical. Trophic lesions, such as œdema and hæmorrhage, as observed elsewhere in the body, may exist in the brain, according to his view. Hysterical hæmatemesis, hæmoptysis, and ecchymosis are well known; there is no reason why similar lesions should not be found within the cranial cavity. There was no autopsy in either of the cases; if there had been, the hysterical nature of a hæmorrhage could not have been demonstrated in this way. Gilles de la Tourette (*Bull. et Mémoires de la Soc. des Hôp. de Paris*, June 4, '96).

The changes that old age brings are universally recognized as predisposing to apoplexy. This has, in times past, led to the assumption that cerebral hæmorrhage was only a matter of years. Because senility is added to the other factors this trouble is more frequent in the aged, though it has been found that in the very old cerebral thrombosis is a more frequent result. But, as the pre-

vious causes are quite as common in the younger or stress years of life, there is no immunity at any period.

Distinct from the above are the immediate provoking causes, of which there are many: straining at stool, lifting of heavy weights; plethoric states, as after excessive eating; rage, fright, the sexual act or other great excitement, severe coughing, meteorological conditions (rise in barometer, fall in atmospheric temperature), etc., come under this head. These all act by increasing the blood-pressure. Presumably they are, of themselves, insufficient without previous vascular change.

Hereditary influence. Case of a man of 25, who had a bilateral cerebral hæmorrhage, whose father and one brother died of left hemiplegia at 58 and 28 years, respectively, and whose sister died of apoplexy at 25 years. No history of syphilis. Bernard (*Bull. de la Soc. Anat.*, No. 26, '93).

Case of cerebral hæmorrhage in a woman of 52, with tumors of the parotid and frontal regions, who received 28 cubic centimetres of chloroform, the anæsthesia lasting one hour and five minutes. Coma followed at once, lasting eight hours; then she gradually recovered, showing left-sided complete paralysis of the arm, less complete of the leg and right side of the face, with complete insensibility in the left arm, less marked on the entire left side of the body. She slowly recovered. Boureau (*Revue de Chirurgie*, July, 1902).

Pathology.—This resolves itself into three questions: (1) as to the vascular changes preceding or attending the rupture, (2) as to the blood thrown out, and (3) as to the changes of nerve-tissue resulting therefrom.

1. In the usual spontaneous cases we find some alteration of the vessel-wall that weakens their resistance. Fatty and atheromatous degeneration is common in the aged, and appears earlier in

those who have done heavy lifting, over-indulgence in alcoholics, or for any cause developed premature senility. Nephritis and the uric-acid diathesis lead to arteriofibrosis, which later breaks down. Specific arteritis leaves an atrophic condition of the vascular wall, and this may, in time, yield. Aneurisms (miliary) sometimes develop, as found by Bouchard and Charcot, doubtless on the basis of some of the conditions just mentioned, and presently one or the other of these may give way. Later studies have shown that far from all spontaneous cases are due to the rupture of such aneurisms. We must conclude that weakened spots sometimes give way directly; *i.e.*, without the intervention of such dilatation.

Three cases of multiple lesions of the brain. These are very uncommon, having been the only ones found out of a total of 4000 post-mortem examinations. Clinically they are interesting because the symptoms during life did not lead to suspicion of the presence of the extensive lesions found post-mortem. In the first case there was headache, unconsciousness lasting two hours, and muscular twitchings, but no paralysis after a hæmorrhage consisting of more than an ounce of blood. After the second hæmorrhage there were headache, spasm, but no motor paralysis, hemianopia, and dementia, and yet the second clot was larger than the first, and it was only after the third attack, when more than five ounces of blood was effused, that hemiplegic symptoms and coma supervened. This case is an example of the adaptability of the brain to rapid increases of intracranial pressure. Freyberger (*Edinburgh Med. Jour.*, Nov., 1901).

In numerous other cases purely local troubles so undermine the vessel's strength that it ruptures. The writer has shown this for foci of softening; these erode and weaken the wall of some vessel in the involved area; then,

of course, rupture easily results. Embolism also, and in like manner, sometimes occasions an early break at the point of plugging. Then tumors not rarely so weaken and drag on the local vessels that small and large hæmorrhages result.

There is no conclusive evidence that either increased blood-pressure or nervous influences are ever of themselves sufficient to rupture a brain-artery, without pre-existing degenerative changes in the vessel-wall.

Though any part of the brain may be the site, there are certain favorite starting-points. These correspond to the territory of the terminal arteries, *viz.*: the pre- and post-perforating and the branches from the basilar entering the pons. Statistics regarding site have been collected in this country by Dana.

Seventy-seven personal cases apparently confirming Dana's views. Longest duration since attack had been twenty-two years. E. D. Fisher (*N. Y. Med. Jour.*, Jan. 5, '95).

Four cases of traumatic cerebral hæmorrhage, in all of which the vessel ruptured was the middle meningeal. In one case, a man aged 75, operation resulted in perfect recovery. Rasing (*Hospitaltidende*, No. 3, '93); Littlewood (*London Lancet*, Feb. 17, '94).

2. As to the blood thrown out. There is less resistance to the outflow in the gray than in the white matter. It may vary in quantity from minute capillary extravasations up to those of several ounces. Some coagulation soon takes place in the extravasated blood; but before this has occurred the blood—if, *e.g.*, it has found a way into the cavities or meninges—may have scattered widely in these spaces and have even passed over in part to the other side. Where, however, it has not broken through, but been retained in one focus, it remains long enough and sufficiently fluid to

work its way into all accessible interstices. This is assisted, so long as the flow continues, by the pressure of the blood in the ruptured vessel. As a consequence, the focus is always irregular and ragged in shape. Much also depends on the surrounding structures; if these are stratified tracts the blood naturally makes a long pocket; if, however, these are soft tissues or matted fibres, then a more globular focus results.

The free fluid and granular material is gradually absorbed, leaving the characteristic brownish pigment and sometimes pulaceous material that long remains like a cyst.

Experimental studies to determine the age of hæmorrhagic extravasations. Hæmorrhage artificially induced in rabbits through a trephine-opening. Animals lived from one to seventy-two days. Certain changes in cellular metamorphosis and in chemical character found to occur with marked constancy. Most marked changes corresponded with the first, second, fifth, sixth, eighteenth, twentieth, and forty-fifth days. Hæmosiderin is the chemical medium through which the age of the hæmorrhagic extravasation may be approximated. Herman Durck (Review of *Insanity and Nerv. Dis.*, June, 94).

3. Changes of nerve-tissue, caused or provoked by the hæmorrhage. The primary effects consist of tearing and compression of the surrounding substance. The fibres and gray matter may be forced apart, but often they are ground up, disintegrated, and mixed with the blood, making a pulp into which project abundant fragments of severed tracts. Where fibres are simply forced apart, there may be scarcely any of this chowdering, the compression of adjacent tissues being then all the greater. In limited effusions the compression is exerted chiefly on the immediate neigh-

borhood; but, where the volume is considerable, it may affect the whole brain, as is shown by the vomiting, coma, etc.

Nerve-fibres once severed do not, so far as we know, ever reunite; consequently loss of function due to this cause must be permanent. On the other hand, fibres whose function is disturbed by compression or cedema *may* yet regain their usefulness, and to this is due the degree of recovery that we often see. For on this acute stage there follows one of reaction. It is largely due to the accompanying infiltration and inflammatory cedema of adjacent parts that so many cases end fatally in from two to ten days. Even where life is retained this reaction still further jeopardizes neighboring structures and diminishes the extent of eventful recovery.

There are finally certain secondary changes of nerve-tissue that may develop. These affect only such nerve-fibres as have either been directly severed by the effusion or so much involved as to be unable to recover even their trophic function. Then the portions of these neurons that have been cut off from their respective cells undergo degeneration the same as do severed fibres in peripheral nerves. In the case of the pyramidal or spinal motor tracts this degeneration may extend down the cord to the anterior horns; but the terminal, or spinal, motor neurons, being independent structures, are not generally involved in this process. Of course, fibres going to other parts of the brain will degenerate in like manner if severed from their parent-cells. While in the peripheral nervous system there may be a regeneration of severed or degenerated fibers, nothing of the kind is known to occur in the central nervous system.

Prognosis.—This must be based on the following factors and on the accuracy with which we can determine them. There are, however, two separate questions in the matter of prognosis: one has regard to the continuation of life and the other to the extent of recovery from the attack.

The age of the patient. In childhood the rare cases that do occur are usually severe; but, if the attack itself is outlived, the natural recuperative power is so great that the person will live on indefinitely. Improvement may be expected for some years, but entire recovery is unusual.

In middle life the outcome depends on the causal trouble and the severity of the apoplectic attack. Where the motor involvement is not great or is due to indirect pressure, practically complete restitution of all functions is occasionally observed. More often some impairment of the involved area remains. If the primary cause still obtains, this also interferes with recovery and the general outlook.

In senile conditions (tortuous or calcified arteries, dry and wrinkled skin, arcus senilis, etc.) but limited recovery is to be expected. Life may be prolonged, but most depends on the promptness with which the attack is checked. The subsequent length of life depends much on the kindness and care with which the chronic invalid is surrounded.

Nephritis. Here we must distinguish between unimportant secondary or casual albuminuria and real kidney disease. The latter, when present, limits recovery and determines the eventual duration of life. Even with this complication, however, if the site and extent of the effusion be favorable, the paralytic condition may be fully recovered from.

Syphilis. The existence of this systemic infection is principally of etiological importance. It may constitute an indication for treatment, but otherwise has little significance.

Severity and nature of the attack. This is the great guide to prognosis.

Coma, stertor, vomiting, prolonged semiconsciousness, extensive and complete paralysis, etc., indicate a large effusion with much damage to the brain, both in local destruction and general shock. Consequently there is immediate danger to life and much less chance of functional recovery when life is prolonged. In proportion as these features are less prominent the chances for preservation of life and for recovery are increased.

Prolonged high temperature, or a rise to 104° or 106° F., makes a fatal prognosis probable.

General convulsions, as indicative of ventricular rupture (barring uræmia), are a particularly-bad omen, death usually resulting in from a few hours to a few days.

Location and size of the lesion. These two features are complementary. For, though much depends on the site, still a large outpour by its mere volume may include temporarily all the effects of the smaller, and certain general effects in addition.

Pontile hæmorrhages are more often promptly fatal, doubtless from the importance of the local centres and passing tracts. The outpour is also more rapid because from relatively large vessels and close to the parent-trunk. On the contrary, hæmorrhages of the pallium (that part of the cerebral hemisphere above the central ganglia) commonly become vast in size before inducing as serious symptoms.

Inequality of the pupils developing as

a part of the attack, especially where the larger is on the side of the supposed hæmorrhage, suggests a large focus, and hence points to a more serious condition. This is, however, by itself quite indecisive.

After the acute stage has been tided over the extent of presumable recovery is the main matter for prognosis. Here, besides the points already presented, other manifestations have to be considered. The state of the tendon-reflexes in the involved area must be determined; if there is any increase compared with the other side, we can pretty safely conclude that some permanent injury of nerve-tracts will remain, though a slight local increase is not incompatible with apparent functional recovery. Any marked increase of these reflexes—as ankle-clonus or wrist-clonus or a knee-jerk of ten inches, say—means lasting paralysis. The occurrence of œdema or contractures in the paralyzed part signifies so grave a lesion of the motor path as to preclude hope of recovery.

The anæsthesias that are so frequently present in the early or acute stage rarely prove lasting. The occasional development of chorea in the affected extremities is in so far a good sign as it indicates returning conductivity of the motor tracts.

Three important prognostic indications: 1. Renal disease the most important. 2. Cheyne-Stokes respiration. 3. Hyperpyrexia. If one, two, or all three be present, patient will, in all probability, not recover. Diabetes, chronic alcoholism, typhoid fever, idiopathic anæmia will also exert fatal influence. A. G. Barrs (Brit. Med. Jour., May 18, '95).

Treatment.—It cannot be too strongly urged that the first *desideratum* is a correct diagnosis. Upon this must our treatment primarily depend to be efficacious, since the affections that most

closely simulate cerebral hæmorrhage demand directly opposite treatment.

As the therapeutic indications in cerebral hæmorrhage vary considerably according to the stage of the trouble, they can best be considered under four heads:—

Prevention.—In general the prophylactic management is indicated by the etiological factors. If there are any suspicions of prodromata, the patient must be warned against all lifting and straining, the bowels be kept free (calomel or salines), any overtension of the pulse be eased by mild depressants, and the patient kept in a warm atmosphere well protected from all chilling. Digitalis and cardiac stimulants of every sort should be carefully avoided. Any nervous overtension can advantageously be remedied with bromides, and their use here is regularly in order.

During the Attack.—Some cases are promptly fatal, meningeal and ventricular forms being usually of this kind. Nearly always, however, the effusion progresses for some time. It is here that the physician can be of great service, and as there is rarely time to call for consultants it is important that every practitioner understand the methods fully.

The first and main object is to stop further hæmorrhage. *Our efforts should be directed to a lowering of the arterial pressure, and to a derivation of the blood-current to other parts; i.e., in general to a reduction of the supply to the brain.* For this purpose a variety of means are available and when promptly applied are successful.

Management of cerebral hæmorrhage and its abortive treatment: 1. Do not give stimulants. Their use in such cases is most reprehensible. The patient is prostrated, and the lay mind naturally turns to tonics and bracers: about the

worst thing that can be done. 2. Do not resort to saline injections. During the acute stage a limitation of fluids is in order. 3. Do not use the depressant diaphoretics, such as ipecac, pilocarpine, or apomorphine. They tend to nauseate: an inclination otherwise too common, and, in the degree of attempts at vomiting, most undesirable. 4. Do not prescribe digitalis. It is a dangerous drug in any individual with a liability to apoplexy, and for this, if for no other reason, of unquestionable utility in nephritis. If anything of this sort must be used, strophanthus, in the author's experience, is by far the safest. 5. Do not resort to opiates. 6. Do not try nitrites. 7. Do not permit any muscular exertion on the patient's part; and moving by others should be limited as much as possible.

In the *subacute stage* the important question is: when should the patient be encouraged to sit up? He should be kept as quiet as possible for the first few days, lest further effusion occur from the same vascular rupture. In about a week sitting up should be encouraged. Give vascular depressants in lesser dose at this time. Care should be taken that the patients should not be allowed to remain listless and thus a secondary dementia be favored.

In the *chronic stage*, which is often hopeless enough, the use of nux vomica, massage, electricity, etc., is to be tried. The chief benefit will be derived from cultivating in the patient whatever power remains. William Browning (New York Med. Jour., Feb. 15, 1902).

Position of the Patient.—The main essential is a sufficiently prone attitude to insure complete relaxation of all the muscles, since we know that muscular effort tends to increase arterial tension. On the other hand, dropping the head too low favors the flow of the blood to the brain: a principle that we apply in cases of fainting, anæmic exhaustion, chloroform syncope, etc. The best position, then, for a patient with progressing cerebral hæmorrhage, is to have the body

sufficiently reclining to be fully relaxed and the head considerably elevated.

When a patient has sunk into a state of unconsciousness from brain compression from intracranial hæmorrhage, a recovery from this state will not occur unless the compression is relieved. Warbasse (Brooklyn Med. Jour., Jan., '99).

Sometimes the vomiting in such a case appears to be eased by turning the person on the right side; it is further claimed that turning the person on the paralyzed side eases the stertor.

Vaso-drugs.—The proper use of these remedies is our most valuable single resource. Ergot can well be discarded. The cardiovascular depressants—gelsemium, veratrum, or aconite—are sufficiently powerful and yet ordinarily safe means. Either of these can be administered hypodermically, though they also act promptly by the mouth. Where the pulse warrants its use, it is well to begin with gelsemium. In adults the fluid extract can be started with an initial dose of 2 to 5 drops and followed by drop-doses at intervals dependent on the closeness with which the case can be watched. It should be pushed until its physiological action is manifest, whether little or much is required. The full benefit of the drug is not obtained unless its paralyzing effect is secured.

When medication on this line has to be continued for any length of time, it may be necessary to change, especially from full doses of gelsemium. Then the others become useful. Veratrum is next in order; and both because of the more general familiarity of the profession with this drug, and of our knowledge of its safety from the ample experience with its use in puerperal eclampsia, it will, with most practitioners, prove the most acceptable remedy from the start.

With the use of aconite for this purpose I have no experience; but, relying on its physiological action, there is no doubt that in the absence of either of the other drugs this might be a fair substitute. It is usually advisable to keep up some influence of this kind for from a couple of days to a week.

The use of nitroglycerin in this stage of brain hæmorrhage almost certainly does harm, and should be abandoned.

All stimulants, vascular tonics, morphine, or opiates, and, for the time, strychnine should be carefully avoided.

The possibility of increasing the coagulability of the blood by internal agencies does not yet seem to have been realized.

Autodepletion.—This can be practiced by constriction of the extremities near the trunk. This is a very promptly-acting, but temporary, expedient with many limitations. A coarse binder should be used. Brittle vessel-walls are a distinct contra-indication. Only sufficient force should be used to more or less shut off the veins without affecting the arteries (if too much we but strangle the extremity; if too little we fail of our purpose). Care must be had lest the extremity become too cold. Finally the constriction must be eased up gradually, lest the sudden influx into the general circulation again start up hæmorrhage.

Warm bottles to the extremities, mustard to the soles, and gentle frictions are, of themselves, useful in drawing blood to the parts, and are doubly so when constriction is resorted to.

Compression of the carotids is a doubtful measure, as the vessels in older patients are easily injured and a steady control of the current for any length of time is rarely possible. Ligature of a carotid is literally adding injury to insult.

Ice to the head is a popular plan, but also of very uncertain value. If used at all for this purpose, it might far better be applied over the carotids in the neck.

Depletion of Body-fluids.—Formerly this was the main treatment, and practiced in the form of venesection. Many still think highly of this procedure for vigorous patients with a tense pulse. "The indications for venesection are a regular, strongly-acting heart, and an incompressible pulse."

The most common and still accepted method is by purgatives, as a drop of croton-oil on the tongue, a good dose of calomel, or a glycerin-and-sulphate-of-soda enema.

Pilocarpine might be admirable, since it acts both as a depressant and a fluid-depleter, but for certain risks, as of pulmonary œdema.

There may be other matters that require attention. Convulsions should be promptly stopped, and for this purpose a few whiffs of chloroform may suffice. The efforts of vomiting are injurious, but it is seldom possible to arrest them.

If the bladder is full, catheterization may be necessary.

Treatment of the Reaction (or the Sub-acute Stage).—Here there is still some shock, an actual destruction of brain-tissue, a compression of adjacent tracts by the extravasation, and an inflammatory reaction of immediately-surrounding parts. We have little to offset this. Counter-irritation can hardly act that deeply. Iodides, to favor quick absorption of clot, are the routine treatment.

Trephining, with evulsion of clots, would be in order in this condition, although, owing to difficulty in exact localization and the usual depth of the focus below the surface, such operative relief is rarely feasible. During this period we may have to continue de-

pressants, and wait with *nux vomica* or its alkaloids. "Negatively the use of *digitalis* in a patient who has once suffered from brain-hæmorrhage is ever after a risky matter."

Case of traumatic hæmorrhage into the white brain-substance followed by aphasia, hemiparesis, and Jacksonian epilepsy. Recovery after surgical interference.

Conclusions: 1. Extravasations of blood of traumatic origin can be removed from the brain-substance by surgical methods, as well as contused and destroyed brain-substance, and in the same manner pathological and circumscribed portions of brain-matter. 2. It is possible that extravasations of blood other than those of traumatic origin may be removed by surgical interference. 3. The brain does not resent surgical procedures more than any other part of the body. Borsuk and Wizel (*Archiv f. klin. Chir.*, B. 54, H. 1, '97).

Two cases of cerebral hæmorrhage treated by trephining with a view to evacuation of the clot. In the first case a hæmorrhagic cavity was exposed in the right parietal lobe, and several clots mixed with *detritis* of cerebral substance were removed, the operation resulting in a rapid and complete cure. In the second case a clot could not be found, but the patient gained considerable benefit from the relief of intracranial pressure due to the exploratory trephining. The author, in discussing the question of surgical intervention in cases of cerebral hæmorrhage, puts on one side the proposal to ligate the common carotid. The benefit to be derived from this operation he holds to be illusory, as it cannot influence existing lesions, and that it can do good in preventing renewed hæmorrhage has not been proved. Moreover, it is undoubtedly a grave procedure and may by itself cause death. In the author's opinion, the surgeon should endeavor to expose by trephining the seat of hæmorrhage, to suppress cerebral compression by removing the clots, and also to prevent or overcome infection of the attacked portion of brain by drainage. The cranium,

it is suggested, should be trephined over the fissure of Sylvius.

The dura mater, having been exposed by an orifice from 3 to 4 centimetres in diameter, should be incised, and the brain punctured by an exploratory needle in the direction of the internal capsule. If a hæmorrhagic focus be discovered, it should be exposed by incision of the cerebral substance and the cavity be freely laid open and drained by gauze. This operation will, it is stated, often remain simply an exploratory one, and in many cases—as, for instance, those of abundant effusion and ventricular and bulbar hæmorrhages—such treatment, the author acknowledges, will be quite useless. In certain cases, however, life may be saved by exposure of the region of hæmorrhage, and the mode of intervention proposed by the author is held to be free from risk. Lambotte (*Ann. et Bull. de la Soc. de Méd. d'Anvers*, July-August, 1902).

For the hemiplegic after the condition has settled down into the chronic stage our resources are sadly limited. Strychnine or its congeners internally, sometimes electricity locally to the muscles, and care of the general health comprise all that is rational in customary procedure.

Recently a German writer has done good service by calling attention to the importance, in these cases, of doing everything to bring activity again into the patient's impaired nerve-tracts. He shows that by rousing these persons, lifting them—when not too feeble—into a sitting position, getting them once more interested in life; further, by exercising actively and semipassively the paretic muscles, we can save the patient from the further degeneration that so often ensues and may even effect great gain. To the value of this principle I can heartily subscribe. Ere beginning this plan, however, we must wait until the danger of immediate relapse is past,

—say, usually until the end of the first week or ten days.

WILLIAM BROWNING,
Brooklyn.

CEREBRO-SPINAL MENINGITIS.

See MENINGITIS.

CERIUM.—This is an exceedingly rare metal, found in nature only in the form of a hydrated silicate. Its chief source is a Swedish mineral known as cerite, though it also occurs in brown apatite, and is always found in connection with lanthanum and didymium. Unfortunately the salts that are employed medicinally are often found disappointing in therapeutic efficacy, owing to the presence of these two latter minerals. Cerium is white, very brittle, almost infusible, and insoluble in water. Its salts appear as white granular powders that for the most part are only slightly soluble in water and alcohol, and one, the oxalate, is wholly insoluble therein; with the exception of the valerianate, all are practically odorless and tasteless.

Preparations and Doses.—Cerium bromide, 5 to 20 grains.

Cerium nitrate, 1 to 10 grains.

Cerium oxalate, 2 to 15 grains.

Cerium valerianate, 1 to 10 grains.

Physiological Action.—Practically nothing is known as to the physiological action of the cerium salts; not even their elimination is understood. They are, however, tonic, sedative, and antacid, and the bromide and valerianate are also to some degree antispasmodic.

Therapeutics.—The bromide salt is a comparatively recent introduction, but it is the least valuable of the bromides, and as a tonic and sedative inferior to other preparations. The nitrate was in-

troduced by Sir James Y. Simpson as substitute for bismuth salts, nitrate of silver, and hydrocyanic acid. "In chronic intestinal eruption, a peculiar and intractable form of disease for which arsenic and silver nitrate are generally prescribed, Simpson employed the salts of cerium with marked advantage" (Waring).

GASTRIC DISORDERS.—In irritable dyspepsia attended with gastrodynia, pyrosis, and chronic vomiting there is no remedy so prompt and satisfactory as cerium oxalate or valerianate; both, too, often afford ready relief in the vomiting of pregnancy; but, as before remarked, it is desirable that the salt be pure.

In seasickness French authorities praise the valerianate; but here it is admittedly greatly inferior to amyl-nitrite given by the mouth.

Oxalate of cerium tried in seasickness in doses of 10 to 25 grains every two to three hours. It is superior to any other means personally tried. Also found serviceable in hundreds of cases of sick headache and in the morning sickness of pregnancy, but it must be in doses of at least 10 grains to do any good. W. H. Gardner (Med. Record, June 2, '88).

Cerium given in seasickness in doses of $\frac{1}{2}$ ounce every two hours in a number of cases. Opinion expressed that it will relieve more patients than any other remedy yet suggested. M. C. Waldron (Med. Record, June 23, '88).

In diarrhœal conditions, or any form of irritation of the intestinal tract, either the oxalate or valerianate prove far superior to any of the bismuth salts; so also in any form of vomiting that is reflex from intestinal or cerebral irritation, spasmodic in character.

NERVOUS DISORDERS.—Whooping-cough, too, is sometimes relieved in a most striking way by salts of cerium.

In epilepsy, chorea, and other convulsive diseases in which nitrate of silver

is frequently employed, cerium salts deserve trial, for, as Simpson remarks, they are certainly attended with the advantages that, at the same time, they act as tonics and sedatives. Their use may be persevered in without endangering appetite or digestion and without fear of discoloring the skin.

In some cases of migraine the cerium salts afford speedy relief; but it is probable that here the chief value of the remedy lies in its antacid effect.

In the gastric crisis of locomotor ataxia cerium oxalate may be employed with decided success. The duration of the attack is lessened, the vomiting greatly reduced, and the pain and nausea relieved, sleep returns, and alimentation is, to a certain extent, possible. Ostan-koff (La Méd. Mod., Aug., '96).

Case of a woman, 40 years old, hysterical, who was accustomed to take oxalate of cerium, and who finally developed a cerium habit. She once took $\frac{1}{2}$ ounce in six hours and during two months ingested 5 ounces. No apparent effect was noticeable, though she declared it made her "feel more comfortable." Craigen (Med. Standard, Sept., '96; Med. Age, Oct. 26, '96).

CESTODES. See PARASITES, INTES-TINAL.

CHALAZION. See BLEPHARITIS.

CHANCER. See SYPHILIS.

CHANCROID. See SYPHILIS.

CHAPPED LIPS. See MOUTH.

CHAULMUGRA-OIL.—This is a pale-brown or yellowish-brown oil obtained by expression from the seeds of the *Gynocardia odorata*, which is a native of farther India, more particularly of the Malay Peninsula, and is most abundant in the forests between Sikkim and Rangoon. It is always solid and unctuous in the temperate zone; has a disagree-

able taste and smell; and is a compound of palmitic, hypogæic, cocinic, and gynocardic acids, of which latter a fair product will usually yield from 10 to 12 per cent. The oil generally found in market is rarely pure; and doubtless its variable characteristics are responsible for the fact it no longer enjoys in Europe and America the reputation that obtains thereto in India and the Orient.

Gynocardic acid is the active constituent. It is a yellow, unctuous solid with acrid, burning taste, the odor of the oil, and melts at 85° F. With sulphuric acid it strikes a green color, which has been cited as a test for character and purity; but, unfortunately, palmitic acid gives the same precise reaction.

Preparations and Dose.—Chaulmugra liniment.

Chaulmugra-oil, 5 to 30 minims.

Chaulmugra ointment (1 to 3).

Gynocardic acid, 1 to 5 grains.

Physiological Action.—Chaulmugra-oil (or chaulmoogra-oil) and gynocardic acid alike appear to be highly alterative and tonic in action. Both, in medium doses, leave an unpleasant taste in the mouth, and likewise some irritation of throat and pharynx; later a feeling of nausea supervenes, with oppression in the epigastrium, followed, perhaps, by vomiting, usually by slight purging, after which all symptoms quickly subside. The gynocardic acid is less likely to produce nausea; hence is more readily tolerated. Under continued administration nutrition seems to be improved, and a gain in weight is likely to be observed.

Applied locally, both are demulcent and lubricant; but, like all fatty substances, they act more benignly when the acute stages of inflammation have passed. This fact should always be borne in mind when prescribing as an ointment or liniment or when applying

pure in skin affections, to inflamed joints, etc.

Therapeutics.—The inhabitants of southeastern Asia have long employed chaulmugra-oil, both externally and internally, in the management of leprosy, skin diseases of a chronic scaly variety, in scrofula, rheumatism, etc. Its most prominent effects have been observed in the tubercular and anæsthetic forms of leprosy.

Case of macular leprosy in boy of 14. Patient first manifested signs of the disease at the age of 10, when erythematous and pigmented raised patches, mostly anæsthetic, appeared on various parts of the body. Chaulmugra-oil was given in doses of 12 drops daily with persistent increase, so that by the end of a year the daily quantity had become 400 minims. The anæsthesia, swelling, and erythema entirely disappeared from the patches, and the pigmentation was rapidly fading. T. D. Savill (*Lancet*, i, p. 1283, 1900).

In psoriasis, lupus, and allied skin affections; in old eczemas with thickening of the skin; in scabies and ring-worm; in the form of liniment as an application in rheumatic arthritis, rheumatic gout, stiff joints, and strains. Mixed with chloroform and menthol it appears to have been very beneficial in some cases of neuralgia, sciatica, etc.

In giving the oil internally it is best to begin with 3 or 4 grains, administering after meals, and gradually increasing to the limits of toleration, which will usually be found somewhere between 30 and 60 grains. If the acid is employed, it is best administered in the same way, viz.: $\frac{1}{2}$ grain after meals and gradually increased to 3 or 5 grains. It must be admitted, however, that these preparations do not seem as active in the temperate zone as in the tropics, and that the white races are not so appreciably affected thereby as the dark.

CHEST, INJURIES OF. See WOUNDS AND INJURIES OF THORAX.

CHICKEN-POX. See VARICELLA.

CHILBLAIN. See PERNIO.

CHILLS AND FEVER. See MALARIAL FEVERS.

CHLORAL: ITS DERIVATIVES AND COMPOUNDS.—Chloral, or anhydrous chloral, is by no means chloral-hydrate, as is generally imagined and so very erroneously taught. Chloral, *per se*, is a trichloroacetic aldehyde, and can be obtained only in the form of a colorless liquid, which, when shaken with water, absorbs one molecule of the latter and forms a solid, constituting chloral-hydrate. It also possesses an aldehyde odor; it boils at 201.2° F., while chloral-hydrate only boils at 207° F. By oxidation it forms trichloroacetic acid, and the action of nascent hydrogen reduces it to aldehyde; by the alkalies it is at once decomposed into chloroform and a formate of the alkali employed. True chloral is difficult to keep, and always requires to be tightly corked in a dark-hued container and carefully set away in a dark, cool place. It possesses little interest for the physician, except as being a source of chloral-hydrate, and the fact that sulphuric acid added to the latter causes it to decompose into meta-chloral and chloral.

Preparations and Doses.—Chloralamid (chloralamide; chloral-formamide), 10 to 45 grains.

Chloral-ammonium, 15 to 30 grains.

Chloral-antipyrine (hypnal), 15 to 30 grains.

Chloral-caffeine, 3 to 10 grains.

Chloral-camphor (camphorated chloral), topical chiefly; internally, 10 to 20 minims.

Chloral, croton- (see BUTYL-CHLORAL).

Chloral-formamide (see CHLORAL-AMID).

Chloral-hydrate, 10 to 50 grains.

Chloral-imide (chloralamid; trichlorethylidenimide), 10 to 30 grains.

Chloral-menthol (menthol-chloral; mentholated chloral), for topical use.

Chloral-ose, or chloralose, 1 to 3 grains.

Chloral-quinine, 3 to 10 minims.

Chloral-thymol, topical application only.

Chloral-urethane (ural; uraline; uralium; urethane-chloral), 10 to 45 grains.

Chloral suppository, 15 grains of mixture.

Chloral syrup, 30 to 120 minims.

Chlorobrom, or chloro-brom: a mixture of potassium bromide and chloral-amid.

Bromochloral, compound liquid of, 30 to 120 minims.

Butyl-chloral-hydrate, 15 to 30 grains.

Butyl-chloral mixture, 4 to 8 drachms.

Butyl-chloral pills, 1 every one or two hours.

Butyl-chloral pills with gelsemium, 1 every one or two hours.

Chloral-ammonium is a white, crystalline powder with a chloral odor and taste, soluble in alcohol and ether, insoluble in cold and decomposed by hot water, melting at about 147° F. It is employed as an hypnotic and analgesic, is claimed never to disturb the stomach, and to be devoid of all the unpleasant factors peculiar to chloral-hydrate: claims by no means substantiated. It is employed chiefly in nervous insomnia of all kinds and also in mental troubles.

Chloral-antipyrine is, perhaps, better known by its trade name: "hypnal." It is scarcely so much a chemical as a mechanical compound, and is had in colorless crystals that are soluble in six

parts of water. It is hypnotic, analgesic, antipyretic, and antiseptic, and chiefly employed in insomnia, headache, spasm, cough, etc.

Chloral-hydrate is the drug in most frequent use, and, as already remarked, is obtained by the addition of one molecule of water to anhydrous chloral, whereby are formed crystals (monoclinic prisms) melting at 135° F., and at 207.5° separating into chloral and water; the vapor is not combustible. It has a somewhat pleasant, penetrating, pungent, aromatic odor, in which, also, is speedily recognized more than a mere suggestion of acidity. Bitter to taste, it is also, in some degree, caustic; is more or less volatile according to the atmospheric conditions to which it is exposed; soluble in almost anything and everything, including fixed and volatile oils; and, when triturated with equal proportions of stearopteus or camphoraceous bodies, combines to produce a liquid. A great deal of the chloral-hydrate marketed is of impure quality, being in combination with chloral-alcoholate (to the presence of which untoward accidents are frequently laid), hydrochloric acid, chlorides, etc. The test authorized by the British Pharmacopœia is that of sulphuric acid acting on a strong solution of the drug in chloroform, whereby, if absolutely pure, no brown color is developed; the U. S. P. directs the acid to be employed without chloroform and the mixture also to be warmed, and requires it shall not blacken. Manifestly the last test is not as reliable or delicate as that of the B. P. A fair idea of purity can be had, however, by pressing between two leaves of blotting-paper, when, if impure, oily spots will be formed. It should make a neutral solution with water without forming oily drops; should not be decomposed readily by the

action of the atmosphere; the aqueous solution acidulated with nitric acid affords no evidence of chlorine when treated with silver nitrate.

Chloral-caffeine appears as colorless, glittering, small rods or leaflets, soluble in water. It is said to be a molecular combination of the drugs represented, but this has never been definitely proved; certain it is that alkalies decompose it into chloroform and caffeine. Being hypnotic, sedative, and analgesic, it has been employed, both by the mouth and hypodermically, and in nervous insomnia, neuralgia, sciatica, rheumatism, headache, etc.

Chloral-camphor or camphorated chloral, *thymolated chloral*, *carbulated chloral*, *quinine-chloral*, and *mentholated chloral*, with the exception of the first named, are employed only in a topical way; all are made by melting the respective constituents with chloral. Thus the camphorated—which appears as a transparent, almost colorless, syrupy liquid—is prepared by triturating equal parts of gum camphor and chloral-hydrate in a warm mortar; it is soluble in all proportions in alcohol, ether, oils, and fats, but not at all in pure water; is antiseptic, analgesic, and slightly epispastic applied externally, and internally administered powerfully hypnotic and narcotic.

Chloral-phenol is an oily liquid composed of 3 parts of carbolic acid and 1 part of chloral-hydrate; is analgesic and antiseptic, and employed by inhalation, or is topically applied.

Chloral-quinine is another fluid developed by mechanical mixture of two drugs, but is more of a curiosity than a medicament.

Chloral-menthol and *chloral-thymol* differ little from chloral-camphor, and are put to much the same uses.

Chloral-formamide, or chloralamid, is unfortunate in having a rival called chloralimide or chloral-imide, the latter being a trichlorethylidenimide. Therapeutically, they are practically identical, save that the latter is about one-third more active and is not decomposed by water. Both are obtained as bitter, lustrous, colorless crystals, decomposed by heat, soluble in alcohol, 1 to 2, and in water about 1 to 20. They are hypnotic, but not analgesic. The claim is advanced that undesirable effects are less frequent and less marked than from chloral-hydrate, but this is probably true only as regards the measure of activity. Neither are, in any degree, uniform as to action.

Chloralose is obtained from anhydrous chloral and glucose by means of heat, whereby are formed small, colorless crystals of bitter, disagreeable taste, slowly soluble in water, readily so in alcohol. It is deemed an hypnotic, and claimed to act by reducing the excitability of the gray matter of the brain, and also that it is free from the disagreeable after-effects manifested by the heart, and the cumulative tendency that sometimes follow the exhibition of chloral-hydrate. Properly this compound is an anhydroglucochloral, and in large doses is intensely toxic.

Chloral-urethane (known also as chloral-carbamide, urethane-chloral, ural, uralium, and uraline) is obtained by heating chloral-hydrate with urethane, then successively adding concentrated hydrochloric and sulphuric acids. It appears both as colorless, shining, laminated crystals and as a white powder, soluble in alcohol and ether. It is recommended as an hypnotic, especially in epileptic dementia, but is uncertain in effects and disagreeable to take, and

not infrequently nausea and disorders of digestion follow its exhibition.

Chloral-hydrocyanate comes in white rhombic prisms, or as a white crystal powder, soluble in alcohol, ether, and water. It contains 15.33 per cent. of hydrocyanic acid, and is superior to the latter in that it is more permanent, and the dose more exact. One part dissolved in one hundred and sixty-six parts of water makes bitter-almond water.

The "*liquor bromo-chloral compositus*" of the British Pharmacopœia is made by dissolving 1600 grains of chloral-hydrate in 400 minims each of tincture of cannabis Indica, and tincture of fresh orange-peel, 1600 minims of henbane-juice, 30 drachms of syrup, and 4 drachms of fluid extract of licorice; then is added 1600 grains of bromide of potassium, previously dissolved in 7 ounces of distilled water, and the whole filtered; finally sufficient distilled water is added to bring the amount up to 20 imperial ounces.

Chloral suppositories, each containing 5 grains of chloral-hydrate and 10 grains of cacao-butter (*oleum theobromæ*), cannot be made with heat, for even if it should not wholly decompose the chloral, the mixture will not set firm; instead, the combination, which, by the way, is apt to be very irritating, must be obtained by compression in molds. The suppositories are very useful in infantile convulsions where nothing can be administered by the mouth, and each one should be forcibly retained within the sphincter for a few moments, by the finger if necessary.

Syrup of chloral is obtained by dissolving 80 grains of chloral-hydrate in 90 minims of water, and then adding simple syrup enough to make 1 ounce.

Butyl-chloral-hydrate—or croton-chloral-hydrate as it is sometimes, but wrong-

fully, termed—appears in pearly-white crystalline scales possessed of a pungent odor resembling that of chloral-hydrate, and an acrid nauseous taste; it is soluble, 1 to 43, in cold water, freely soluble in rectified spirit, and 4 to 1 of glycerin. It is available in the same way as chloral-hydrate, and is claimed to be more efficacious as an analgesic, especially in neuralgias.

Butyl-chloral-antipyrine or butyl-hypnal, appears as colorless, transparent needles of butyl-chloral odor and bitter taste, which are soluble in alcohol, ether, chloroform, benzin, and (1 to 30) water. Perchloride of iron gives a red solution; alkalies decompose into antipyrine, alkaline formate, and propyl-chloroform. Its properties resemble those of hypnal. Butyl-chloral mixture, which is a very useful anodyne, is made by dissolving 4 grains of butyl-chloral in 15 minims of glycerin and water to make 1 ounce.

Butyl-chloral pills are made of a strength of 3 grains each of the drug added to sufficient glycerin of tragacanth or mucilage of gum arabic to make a mass; when the same are desired with gelsemium, hydrochlorate of gelsemine, in the proportions of $\frac{1}{200}$ of a grain, is added to each pill.

Butyl-chloral syrup is merely 16 grains of the drug dissolved in 1 ounce of hot syrup.

Glycerite of chloral is merely 1 part of chloral-hydrate in 4 parts of glycerin, and is employed chiefly as a solvent for certain alkaloids.

Glycerole of camphor and chloral, which is a very effective anodyne embrocation, is made as follows:—

- ℞ Camphor, powdered, 75 grains.
- Chloral-hydrate, 60 grains.
- Glycerin, 4 drachms.
- Alcohol, 3 drachms.
- Juniper-oil, 30 minims.

Mix in a glass container and expose to gentle heat (not over 104° F.) until solution is effected. Let cool, bottle, and keep well stoppered.

Carmine-chloral—which is so useful to microscopists as a stain, and invaluable in examining pollen nuclei—is made as follows: Carmine, 2; absolute alcohol, 20; hydrochloric acid, 2 parts; heated on a water-bath for thirty minutes; then, adding 25 parts of chloral-hydrate, cool and filter.

Hypodermic Use.—Chloral-hydrate has been administered hypodermically, but is generally to be condemned on account of its caustic action, the necessity of multiplying punctures, and of employing very dilute solutions. Vulpian declares that it tends to induce hæmaturia, though not to the same degree as when employed by intravenous injection. Croton-chloral is a trifle more suitable from a remedial stand-point, but not from a physical one; it is also highly irritant. Leoni recommends the following solution, 16 minims of which contain $\frac{3}{4}$ grain of the drug: Croton-chloral, 16 grains; warm glycerin and cherry-laurel water, of each, equal parts up to 352 minims.

Physiological Action.—Externally applied, all chloral preparations are more or less irritant, but likewise antiseptic and sometimes analgesic.

Internally they are generally sedative to the nervous system, and secondarily to the heart: a feeling of lassitude, of irresistible drowsiness, or even sleep may be produced (though sometimes preceded by a stage of excitement, particularly in alcoholics), slowing of pulse and respiration, and pupillary contraction. Sensibility and reflex excitability are not disturbed by ordinary medicinal doses, but disappear when large amounts of the drug are exhibited. There is also lower-

ing of temperature. Probably brain-anæmia is induced, whereby sleep follows, the act being more nearly normal, physiologically, than that produced by any other drug, there being no *malaise* on awakening.

Liebreich, who first introduced chloral, believed that it exerted its effect through the circulation by liberating therein free chloroform and formic acid; but this seems improbable, because the alkali of the blood is too feeble to effect the transformation, and its albumin is considered antagonistic to such a process. Again, no smell of chloroform can be observed in the breath, and no anæsthetic effect is produced on the sleeper by moderate doses. Farquharson ("Therap. and Mat. Med.," '89).

Chloral has antiseptic properties, destroying low organisms and preventing the decomposition they induce. Small doses are without obvious effect upon the stomach; large doses may be followed by nausea and vomiting. Biddle ("Mat. Med. and Therap.," '96).

Chloral-hydrate acts upon the cerebrum as a powerful and certain hypnotic; acts as a depressant to the centres at the base of the brain; depresses the functions of the spinal cord; produces slowness and weakness of the heart's action, vasomotor paralysis, and muscular weakness with anæsthesia. Murrell, Lond. ("Man. of Mat. Med. and Therap.," '96).

Resemblance of the psychosis of chronic chloral poisoning to natural sleep emphasized. The reason of this will be found in the fact that, like natural sleep, chloralism is the result of a congestion of the brain or of the action of a poison upon the brain-cells. A. F. Akopenko (Vratch, Apr. 29, 1900).

Various drugs have been employed, some of them dangerous, to render people stupid and unconscious as an accessory to robbery. The criminal classes, however, have largely settled down to the use of chloral-hydrate, and it is from 30 to 60 grains of this substance, usually administered with beer, that furnishes the famous "knock-out" drops. Editorial

(Boston Med. and Surg. Jour., Oct. 5, '99).

Butyl-chloral-hydrate acts very much like chloral-hydrate, but is less powerful as an hypnotic, induces somewhat less cardiac depression, is not so irritating to mucous membranes, and appears to have a specific action upon the branches of the fifth pair of nerves. Liebreich believes that its action upon the heart in even fairly large doses is not dangerous, and that life can be saved by means of artificial respiration after the respiration-muscles have ceased action, but the erroneousness of these conclusions has been demonstrated in the physiological laboratory. It is evident that its administration cannot be conducted with much less caution than that of chloral-hydrate. It is largely eliminated by the kidneys as urobetylchloralic acid.

Butyl-chloral-hydrate has hypnotic powers, but it is so rarely used for this purpose that on practical grounds it should be dissociated from the group of hypnotics in spite of many structural and other affinities. It produces anæsthesia of the head without loss of sensibility to the rest of the body, which in man is confined to the area of the fifth nerve. In large doses it produces sleep, and in fatal doses destroys by paralyzing the medulla oblongata. Ringer and Sainsbury ("Manual of Therap.," '97).

Chloralamid.—A marked effect of this drug is its tendency to produce mucous diarrhoea. It acts more powerfully upon the cerebral cortex than any other portion of the nervous system, causing sleep and muscular relaxation; is claimed to be only feebly depressant to the cord, and in medicinal doses to have little effect upon the circulation. It was introduced as a substitute for chloral-hydrate, backed by the assertions that it was less unpleasant to take, absolutely without objectionable effect on the heart, and that its hypnotic effect is two-thirds

that of chloral. Although it acts with tolerable certainty in simple insomnia, it generally fails, if administered in medicinal doses, when pain and excitement are present. On the whole, it cannot be said to have met the expectations raised in its behalf. In moderate doses it seems to sometimes stimulate respiration, rendering it deeper and fuller, but unless its administration is carefully watched an opposite effect is soon produced.

The physiological action of chloralamid is similar to that of chloral upon the cerebrum, but upon the circulation is ordinarily so slight as to offer a marked contrast to the depression produced by the latter drug; only in large or poisonous doses does it depress the heart and cause a fall in blood-pressure. A moderate degree of respiratory depression may follow the administration of large amounts, and death results from paralysis of respiration. It has been thought to have a soothing effect upon the spinal centres and thus to diminish reflex excitability, but its action upon the nervous system other than the cerebrum is hardly appreciable. It is excreted as urochloralic acid. Griffin (Foster's "Prac. Therap.," '96).

Upon the action of this drug a large amount of experience has been accumulated by a number of observers, the world over, and the general verdict is that it does not depress the heart or circulation, does not lower temperature, that it exerts a decided action in many cases of insomnia from pain, and that after-effects and by-effects are rarely witnessed. At the same time it must be admitted that collapse symptoms have been observed in a few cases and likewise erythematous eruptions. It certainly is a very valuable hypnotic. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Chloralose.—This drug was introduced as a substitute for chloral-hydrate, with the claim that it is hypnotic,—causing sleep in birds and mammals as well as in man,—analgesic, exerts its effect

chiefly upon the gray matter of the brain, and unlike chloral does not depress the spinal cord; also that it is without any irritant effect on either stomach or intestines; indeed, that it is entirely devoid of unpleasant after-effects—all of which has by no means been definitely substantiated. It should be administered with caution.

The introducers assert that 75 grains will, in a dog of $2\frac{1}{4}$ pounds' weight, produce symptoms of intoxication followed by a most profound sleep in which all sensibility is lost, although the reflex activities are greater than normal. Upon the circulation the drug has but little power, the arterial pressure—even when there is profound unconsciousness—being scarcely affected. During unconsciousness not only is the motor side of the spinal cord more active than normal, but the cerebral cortex was also found to be extremely excitable. H. C. Wood ("Princ. and Prac. of Therap.," '94).

The toxic dose is about $\frac{1}{10000}$ of the body-weight. When injected into a frog in this proportion produces a condition similar to that observed after removal of the cerebral hemispheres. Spontaneous movements are abolished, but reflex and automatic actions remain intact. Soon afterward, however, respiration is paralyzed, followed by the disappearance of all reflex activity, and the animal lies apparently dead; but on opening the thorax the heart is found beating quite vigorously, this cardiac action continuing for two or more hours after the abolition of the respiratory movement. The sleep produced in man is sometimes preceded by muscular tremors or simple twitchings, dizziness, and difficulty of speech; the sleep is more profound than normal, the patient becomes insensible to pinching or pricking of the skin, and the corneal reflexes seem to be absolutely abolished. Chambard (*Revue de Médecine*, Apr. 10, '94).

The respiration is slowed, and by large doses its rhythm is somewhat altered. Cappelletti (*Uniao Méd.*, Sept., '94).

Chloralose is a prompt and safe hypnotic: it acts more rapidly than any

drug except morphine. It is also more prompt and efficient in smaller doses than chloral. Five grains, the maximum dose, may be repeated in an hour. Nine cases of insomnia referred to, some of them exceedingly severe, in which sulphonal, trional, and other hypnotics prove ineffective. Chloralose produced excellent results. James Tyson (*Jour. Amer. Med. Assoc.*, Apr. 6, 1901).

The action of chloralose is chiefly upon the brain and the spinal cord. On the brain it causes two effects, one of depression and one of excitability, the former intense and lasting, the latter slight and fugacious. The depressant action presents itself as sleep and sedation; the sleep comes rapidly, is exceptionally preceded by intoxication; heaviness of the head, stupor, or moderate cephalalgia, this being often quite marked, but not exaggerated; at other times lassitude, feebleness of the lower extremities, and various other troubles on different days, the narcosis being followed by a feeling of well-being. The drug also has the peculiar property of causing physical blindness; it is capable of producing dilatation of the pupil and diminution of visual acuteness, sometimes accompanied with diplopia. It increases the appetite markedly, and exceptionally may cause gastric disturbances, eructations, thirst, and vomiting. It does not produce an increase in the amount of urine secreted, but causes a relative polyuria immediately after its administration. (Montyel.)

Toxic symptoms observed in two patients: one suffering from diabetes, the other from uterine fibroid, the symptoms being trembling, starting, nausea, vomiting, a species of dull restlessness accompanied by incoherence, and involuntary evacuation of urine and feces. Touvenant (*Le Prog. Méd.*, No. 19, '94).

Three grains of the drug produced poisonous symptoms in a child of 6 years: there was trembling, convulsions,

and later a cataleptiform condition which lasted two hours. Bardet (Le Bull. Méd., Feb. 18, '94).

Nocturnal paralysis followed a dose of 3 grains administered to an adult. Féré (Rev. Neurolog., No. 6, '94).

Trembling and intellectual stupor observed in adults. Morel-Lavallée (Le Bull. Méd., Feb. 7, '94); Villeprand (*ibid.*); Talamon (La Méd. Mod., Jan. 27, '94).

Complete loss of memory in one instance after the ingestion of 4 grains; intense prurigo as the result of a like dose in another; symptoms of paresis with threatened asphyxia in a third. Lombroso (Riforma Med., No. 131, '93).

The ingestion of 4 grains of chloralose in two hours induced complete insensibility and coma; the pulse was 180, the heart-beats imperceptible, face and extremities cyanosed, epileptoid movements of limbs, and cold perspiration. Death seemed imminent. Rendu (Le Bull. Méd., Mar. 10, '95).

Five or six similar cases were published in La Médecine Moderne during 1894. Several were reported to the Société de Thérapeutique. Russian physicians, notably Chemelewski, added to the category. Herzen (Revue Méd. de la Suisse Rom., June 20, '95); Delabrosse (La Normandie Méd., No. 15, '95); and Dufour (Marseille-méd., Dec. 15, '95) corroborate as the result of personal experiences.

The drug has one very important defect in that it occasionally provokes toxic symptoms, which manifest themselves by an exaggeration of the reflex excitability of the medulla oblongata, amounting almost to convulsions; in addition to this, it is very difficult to decide upon the proper dose, as its action varies not only in different persons, but even in the same person. Foster ("Prac. Therap.," vol. i, '96).

Chloral-hydrocyanate has the action of the cyanides; it is about one-seventh as strong as prussic acid. It is an excellent preservative of solutions intended for hypodermic use.

Chloral-caffeine has been introduced for the treatment, hypodermically, of sciatica and other rheumatic affections,

and all cases of irritation of the peripheral nervous system. It has been employed subcutaneously in doses of from 2 to 5 grains, and is said to be painless. Its physiological action has not, as yet, been definitely worked out.

Chloral-carbamide, or chloral-urethane, is hypnotic, partakes of the action of chloral-hydrate, but is uncertain in effects, disagreeable to take, and is often followed by nausea and disorder of digestion.

Hypnal, or chloral-antipyrine, has all the properties of chloral-hydrate, including all the objectionable features of the latter, and depresses the heart more seriously. It is claimed that the antipyrine renders it analgesic, and therefore will induce sleep in the presence of pain; but such action is uncertain and ephemeral.

Butyl-hypnal apparently differs in no way from the preceding.

Chloretone, a new preparation, is soluble to the extent of 1 per cent. in cold water. It is an hypnotic and an analgesic, a 1-per-cent. solution being equal to a 4-per-cent. solution of cocaine. The customary dose is from 6 to 18 grains, but there is a case on record in which 108 grains were taken at one time, which had no other effect than to cause the patient to sleep for about three days. Chloretone passes unmodified from the digestive tract to the blood. (R. W. Wilcox.)

Chloretone has little or no effect upon the pulse, respiration, and blood-pressure for hours, but eventually, if the dose be large enough, these become depressed and the animal dies, the heart stopping before respiration. Chloretone has a profoundly depressing effect upon the body-temperature, lowering this more than any other drug, with the possible exception of alcohol. This depressing effect is evident before the animal is even drowsy, and is in ratio to the dose given.

It may be partially prevented by keeping the animal very warm. Any drug which can exert such an effect upon the total heat of the body is one which requires to be used with great caution in medical practice. This is doubly important, as the drug is very slowly got rid of; no antidote, with the exception, perhaps, of external warmth, is known. Rudolph (*Can. Pract. and Review*, June, 1900).

Chloretone is one of the best of the hypnotics. Usual dose is from 3 to 5 grains at bed-time. It is best given dissolved in alcohol or whisky and followed by a glass of milk. F. F. Ward (*Medicine*, vi, p. 642, 1900).

There is no other efficacious, practical antiseptic that is so conspicuously anæsthetic as chloretone, when applied locally, and at the same time so utterly devoid of any harmful effects, either local or constitutional. T. A. Dewar (*Therap. Gaz.*, Feb. 15, 1900).

Chloretone is especially recommended as an hypnotic and local anæsthetic. There are no depressing after-effects, and it is safe to administer large doses. Ten to 15 grains, repeated in two hours if necessary, is the usual dose. W. M. Donald (*Ther. Gaz.*, vol. xvi, No. 1, p. 18, 1900).

Chloretone is the safest of all hypnotics. It should be given in from 15 to 20-grain doses in severe cases, and repeated often enough to produce the desired effect. For hypodermic use, a saturated solution of chloretone in a mixture containing 15 per cent. of alcohol and 85 per cent. of water is sufficiently strong to produce local anæsthesia for minor operations. A still more powerful local anæsthetic may be produced by mixing equal parts of chloretone and ether. This is particularly useful to dentists as an application to the nerve-pulps when it is advisable to remove them. W. B. Hill (*N. Y. Med. Jour.*, Aug., 1900).

Toxic and Untoward Effects.—The toxic and untoward effects, except as has heretofore been stated, are practically identical to those of all chloral derivatives. It is believed that most of the

untoward results arising during the administration of medicinal doses are due to impurities,—chlorinated substances,—and, fortunately, such are rare. These are, for the most part, disturbances of respiration, including dyspnoea and partial asphyxia; irregular action of the heart; irritation of the conjunctiva; swelling of the epiglottis and false vocal cords; icterus, increased jaundice; bed-sores (rarely); dimness of vision, perhaps even temporary blindness; erythematous, urticarious, and eczematous rashes, etc.

What constitutes a poisonous dose is not known, since so small an amount as 20 grains has induced fatality, while, on the other hand, I have known of the ingestion (by accident) of 480 grains without any ill effects succeeding. Death may arise from cardiac syncope, from paralysis of the respiratory centre with coma and gradual suffocation, or from excessive depression of bodily temperature; a series of cases are recorded in which were evinced symptoms akin to blood-poisoning with purpuric and scorbutic eruptions, ulceration of gums, and great prostration, leading to death.

Treatment of Poisoning.—First, stimulants to the heart and respiration, and, second, attempts directed toward increasing temperature. Strychnine has been heralded as a physiological antidote, because it is antidoted by chloral, but this premise is, unfortunately, not a safe guide; atropine and amyl-nitrite (by inhalation) are more reliable agents; yet strychnine may be valuable as a means of sustaining the action of the heart.

Case of a middle-aged man who was in a mental state bordering on melancholia, due to worry and the use of alcohol. Choral-hydrate, 40 grains, and potassium bromide, 15 grains, were directed every three hours, with a double dose at bed-

time. Prescription was written on Thursday, and the patient was not seen again until the following Monday. He was then found in bed with his knees and chin approximated; the extremities cold, and he was jerking and rolling about. Breathing was slow and stertorous; pulse was slow and soft; face was ashen gray, with parched lips and swollen tongue; there was marked stupor. Since the prescription had been given he had had the prescription filled four times, and had been drinking half a small glassful at a dose. During the time he had eaten heartily and had taken little or no alcohol. It is estimated that during the three days he had taken no less than 8 ounces of the mixture, or 640 grains of chloral and 960 grains of potassium bromide. Recovery was rapid under strychnine. P. F. Rogers (Med. Record, Mar. 10, 1900).

Chloralism is a form of drug addiction which appears to be more common among women. As in all other forms of drug addiction, some previous neurosis will be found to precede the first use of chloral. The sleep which it produces is so profound and followed by no unpleasant sensations that it is repeated as often as occasion calls for it.

Chloral can be taken secretly for a long time without any suspicion of its use. After a time the effect of its use appears in disordered digestion, the irregular heart-action, and the increased nervousness and muscular unsteadiness. In persons past middle life a form of cardiac asthma with a tendency to delirium appears. These and many other obscure symptoms finally merge into delirium and death. Some observers have noticed that chloral-takers have peculiar blueness of the extremities, with venous congestion; also marked listlessness and lack of energy as prominent symptoms of this addiction. Chloralism is confined largely to the more prosperous classes of society. This drug can be disguised in many ways and used as a fascinating sleep-producer. The amount varies from 20 to 2000 grains a day. Often considerable time will elapse before toxic symptoms appear; then, suddenly extreme prostration with

delirium comes on, ending fatally. Sudden palsies, with vasomotor disturbances, heart-failure, and low stages of delirium, should suggest chloralism, particularly if alcohol, opium, cocaine, and chloroform be excluded. The statement of the patient concerning his condition is of no value. Where the history indicated extreme neuralgia and insomnia and a sudden passing away of these conditions, the assumption that chloral is used is possible. When it is established that chloral addiction is present, the patient should be isolated at once and placed under positive restraint and the drug withdrawn. Alcohol, opium, chloroform, ether, and cocaine are all contra-indicated as substitutes. Vegetable narcotics, such as hyoseyamus, valerian, lupulin, bull-nettle, and others of this class, may be given as substitutes and withdrawn at the earliest moment. Then comes the usual tonic treatment of nuxvomica, strychnine, and arsenic. Cinchona and iron are also excellent drugs. The insomnia and neuralgia with deranged nutrition which follow the withdrawal should be treated with baths, foods, and careful hygienic management of all the functional activities of the body. Many secret remedies for neurotic troubles contain chloral, and decided symptoms of chloralism often appear. Chloralism has been mistaken for general paralysis, neurasthenia, and hyperæmia, as well as several affections of the cord. Many opium and alcohol cases are found to be complicated with chloral addiction, and their recovery is more difficult. T. D. Crothers (Med. Standard, Aug., 1901).

Therapeutics.—In convulsive and spasmodic disorders chloral is undoubtedly one of the best remedies in the *materia medica*. It has been found useful in asthma (see RESPIRATORY DISEASES); puerperal, infantile, and general convulsions; chorea and epilepsy; tetanus, trismus, whooping-cough, etc.

RESPIRATORY AND CARDIAC DISEASES.—The value of chloral and its derivatives in respiratory maladies is not so appar-

ent as in many other classes of diseases, but they nevertheless appear to possess a certain degree of utility, especially in certain forms of asthma, laryngitis, bronchitis, etc.

In the sleeplessness of cardiac and bronchial catarrh chloralamid is particularly serviceable. Its influence upon the circulation is feeble, and not at all injurious; hence it may be employed in cardiac maladies. Biddle ("Mat. Med. and Therap.," '96).

Chloral-caffeine in doses of 3 to 4½ grains may be used hypodermically in asthmatic attacks. Foster ("Prac. Therap.," vol. i, '96).

A full dose of chloral is often useful in a paroxysm of asthma; the shortness of breath, which affects the emphysematous on catching cold, also often yields to its influence. When dyspnoea occurs at night 25 to 30 grains at bed-time calms the breathing and gives sound, refreshing sleep; but when the difficulty is continuous, 2 to 6 grains should be given several times daily. It is necessary to give the drug with caution to patients with emphysema and bronchitis accompanied by obstructed circulation manifesting itself in lividity and dropsy. Ringer and Sainsbury ("Hand-book of Therap.," '97).

MENTAL DISEASES.—Chloral derivatives undoubtedly have a special value in this class of maladies by reason of their hypnotic action. Chloral-hydrate especially causes sound, refreshing, natural sleep; but no chloral preparation is to be depended upon, save in special instances or when topically applied, as an obtundent of pain.

In physical derangements, running all the way from nervous excitability up to delirium tremens, puerperal eclampsia, acute mania and tetanus, in nervous asthma and hiccough, chloral-hydrate is an excellent remedy. Roth ("Mod. Mat. Med.," '95).

In eighty-two cases of insanity a sedative effect was noticed in from fifteen

to twenty minutes after taking chloralose; the most satisfactory results were obtained in maniacs, epileptics, and alcoholics. Haskovec (*Revue Neurolog.*, Oct., '95).

DISEASES OF KIDNEYS AND GENITO-URINARY ORGANS.—Few seem to be aware of the value of the chloral derivatives in disease belonging to the above classes, and, perhaps, the most startling claim advanced is the one that accredits chloral-hydrate with being a most valued agent in the treatment of ailments characterized by albumin in the urine. The evidence of its value in uræmia, etc., is to be found under the classification of SPASMODIC AND CONVULSIVE DISEASES, which are sometimes benefited by this remedy.

SKIN DISEASES AND NEOPLASMS.—Here the chloral preparations have been greatly employed, and not without reason. Chloral-hydrate, it is claimed, if a strong solution is painted on warts and corns, will insure their gradual disappearance. Chloral-hydrate, chloral-ammonium, chloral-camphor, and chloral-phenol have exhibited some measure of value in the management of stubborn skin eruptions, including pruritus and eczema, and are, at least, useful as topical applications in relieving burning and itching. Chloral-hydrate, in 2- to 5-per-cent. aqueous solution is frequently effectual in relieving bromidrosis and hyperidrosis.

CHOLERA AND CHOLERA MORBUS are maladies in which chloral compounds have been employed, but not with such measure of success as to warrant the practitioner's depending upon them solely.

SCARLATINA AND DIPHTHERIA.—In scarlet fever hydrate of chloral is highly recommended in frequently-repeated small doses,—say, 1 to 5 grains, accord-

ing to age; it has a marked sedative effect, controls inflammation both in throat and kidneys, and even tends to prevent such sequelæ as otitis media and glandular swelling and suppuration. In diphtheria chloral-hydrate or chloral-camphor in suitable solution may be employed as a topical application to the throat and larynx, and the internal administration of the former is often a valuable adjunct to other treatment.

SEASICKNESS.—Chloral preparations are widely advised as a remedy. Though sometimes efficacious, they often prove as futile as others of the host of remedies that purport to be effective.

FEBRILE MALADIES.—It will be readily surmised that chloral preparations, chloral-hydrate especially, may find a place in the treatment of pyrexias, not alone because of its sedative, antiseptic, and hypnotic properties, but also because of its distinct influence upon temperature.

Chloral-hydrate is often employed, and very valuably, in fevers, particularly typhoid and typhus, especially where want of sleep, together with delirium, rapidly wears out the strength of the patient. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Other morbid conditions in which chloral-hydrate, and some other of the chloral compounds have been employed with varying measures of success are: rheumatism and sciatica; as a dressing for bed-sores and other ulcers, including suppurating malignant and non-malignant growths, cracked nipples, anal fissure, etc.; as an application to abort felons and boils; for the vomiting of pregnancy; for a purgative action pure and simple; and as a tæniifuge in conjunction with male fern and croton-oil. The following is claimed by Bonatti to be a prompt, certain, easily administered

drastic purgative, active when even jalap and croton-oil fail:—

R Infusion of senna, 10 ounces.

Chloral-hydrate, 24 to 45 grains.

Syrup, 1 ounce.—M.

After the removal of polypi, the application of chloral-hydrate will often destroy the base of the growth. Its internal administration frequently relieves the pain of acute catarrh of the middle ear, and moreover tends to be remedial by checking and reducing inflammation. A 5-per-cent. solution is sometimes useful to remove granulations in the middle ear, especially if the discharge is markedly purulent. The application of chloral-camphor has sometimes proved effectual in assuaging the pain of mastoid disease.

VESICANT ACTION.—Powdered chloral, sprinkled over adhesive plaster, gently warmed and laid on the skin, makes a speedy, painless, and effective blister, at least equal if not superior to cantharides and more safe as regards children.

When a marked effect is rapidly required, chloral hydrate is better than cantharides and has none of its disadvantages. With children, next to iodine it is the counterirritant of choice. The blister will produce erythema, vesication, or ulceration, as desired. M. T. Brennan (Montreal Med. Jour., May, 1902).

CHLORIDE OF ETHYL. See ETHYL CHLORIDE.

CHLORINE. See derivatives: POTASSIUM CHLORATE, SODIUM CHLORIDE, etc.

CHLOROFORM.—This well-known anæsthetic was simultaneously discovered, in 1831, by Guthrie, of the United

States; Soubeiran, of France; and Liebig, of Germany. Dumas later on gave it its present name, and Sir James Y. Simpson, of Edinburgh, first used it as an anæsthetic.

Chloroform (ChCl_3 ; specific gravity, 1.497 at 62.5° F.) is a terchloride of formyl, obtained by the action of chlorine upon alcohol, the methods usually employed being either the addition of chloral-hydrate to an alkaline solution or of chlorinated lime to ethyl-oxide. This is distilled and subsequently purified by the addition of sulphuric acid, sodium carbonate, and lime, and redistillation is then resorted to.

Chloroform appears as a neutral, colorless fluid, possessing a sweetish and hot taste, and giving off a fragrant and characteristic odor. It possesses marked solvent powers, rapidly dissolving alkalis, iodine, bromine, volatile oils, etc.; but is itself only sparingly soluble in water. It is distinctly so, however, in alcohol and ether.

Chloroform is not inflammable under ordinary circumstances, except when mixed with alcohol. When used, however, in the presence of a gas-flame, it is likely to become decomposed, and the product may prove noxious to the persons inhaling it.

Chloroform-vapors are broken up into chlorine and carbonic oxide by gaslight, causing bronchial irritation in those present, asphyxia in the patient, and even death. Herson-Leidon (*Deutsche med. Woch.*, Apr. 3, '90).

Hydrochloric acid and carbon dioxide, and not monoxide, are the toxic agents. Kunkel (*Münch. med. Woch.*, Apr. 4, '90).

A coal-gas flame in an ill-ventilated room and a somewhat prolonged exhibition of chloroform may, by forming a compound with the latter, induce serious symptoms in patient, surgeon, and assistants. Illustrative instances. Charles G.

Lee (*Liverpool Medico-Chir. Jour.*, July, '95).

Identical effects observed. Irritating agent, a carbon-oxychloride, or phosgene, discovered by Sir Humphry Davy. Patterson (*Practitioner*, vol. xlii).

Warning against use of chloroform near a gaslight, ethylene-chloride being thereby formed. In tabetic patients fatal coma may be induced. Rehn (*Le Bull. Méd.*, May 12, '95).

Case of a man shot in the abdomen, who was brought to the hospital at night and immediately operated upon by gaslight. As a result of the chloroform narcosis, which had to be kept up for four hours, powerful chlorinated vapors were produced. Two of the surgeons and several of the Sisters of Mercy were overcome and one of the latter has since died. (*Inter. Med. Mag.*, Apr., '98.)

The administration of chloroform while artificial lights are burning is likely to produce broncho-pneumonia and œdema of the lungs, with marked passive congestion of the liver and kidneys. This variety of poisoning also occurs with some frequency in druggists and chemists who use chloroform in the presence of gas-flames. Kenelm Winslow (*Boston Med. and Surg. Jour.*, May 11, '99).

Even under ordinary conditions the chloroform usually employed for anæsthetic purposes tends to decompose and to form hydrochloric acid and carbonyl-chloride. According to Newman and Ramsay, this latter substance is the cause of the majority of cases of after-sickness. This can be overcome by keeping a little slack lime in the bottles and filtering in the supernatant liquid as required.

The deleterious effects of chloroform become especially manifest when kept in a bottle containing air and exposed to light.

Physiological Effects and Contra-indications.—The conclusions of Lawrie and of the Hyderabad Commission, the principal of which is that failure of respiration is the only possible way by which death is produced by chloroform,

has now run the gauntlet of several years' criticism and may be said to no longer be accepted by the profession, and especially by experienced anæsthetists. Indeed, many competent observers have reported cases in which the heart ceased before the respiration, and Mr. Leonard Hill has recently expressed the view that the cause of chloroform collapse was in all cases a primary failure on the circulatory mechanism, the respiration failing secondarily on account of the anæmia of the bulbar centres. He had examined all the tracings taken by the Hyderabad Commission, and found that in them (although it was not so interpreted by the experimenters) the same typical fall of arterial pressure actually occurring before the cessation of respiration observed by him elsewhere. Thus their own experimental evidence contradicts the conclusions arrived at by the workers on the said commission.

A correct view would probably include both factors: a conclusion which Horatio C. Wood reached eight years ago, when he said: "If any evidence is to be attached to the statements of competent witnesses it is certain that in some cases, under the influence of chloroform, the pulse and respiration have ceased simultaneously, while in other instances the respiration has ceased before the pulse, and in still other cases the pulse has ceased its beat before the respiratory movements were arrested." Lauder Brunton has since given precision to our knowledge by an exhaustive study of the question, which led him, in the main, to believe that cases of simple danger without death were due to failure of respiration, while death was brought about through arrest of the heart or arrest of the heart and respiration together (neuroparalysis); furthermore, that the most common cause of neuro-

paralysis, as found by Casper, was strangling (as in drowning), which kills by neuroparalysis as often as by asphyxia.

[Variations in circulation due not only to the above various factors, but also to alterations effected by chloroform in the central nervous system and local nervous mechanisms. As shown by Waller, electrical reaction is profoundly altered by anæsthetics; hence distinct danger in conditions of nerve-prostration and post-influenzal neurasthenia. The whole question of reflex inhibition of the heart under chloroform bristles with difficulties. If fear were simply the cause, such cases would occur often under ether, as that substance, when badly given, produces more terror, breath-holding, and struggling than chloroform; and yet ether seldom, if ever, kills in this way. Unquestionably, chloroform—whether through poisonous effects on protoplasm or in some other way—exerts some deleterious influence upon tissues of patients, which renders them less able to withstand any unusual strain imposed upon them. DUDLEY BUXTON, Assoc. Ed., Annual, '96.]

Lowered arterial pressure has a comparatively feeble effect upon the respiration, but, when the pressure falls sufficiently, respiratory depression does occur. Even excessive lowering of blood-pressure primarily stimulates the vasomotor centre, the sensibility of the centre being evidently necessary to the automatic regulation of the circulation. Hence it is evident that the depression of the circulation produced by chloroform has effect upon the respiratory centres only when the pressure has fallen very low, and, while it may be a factor in the production of respiratory failure during chloroformization, the failure must be chiefly due to the direct influence exercised by the drug upon the respiratory centres. H. C. Wood and W. S. Carter (*Jour. of Exper. Med.*, May, '97).

Arrest of the heart is one of the most important causes of collapse during chloroform anæsthesia. The paralysis of the vasomotor centre which is provoked by the latter brings about the rapid fall of the blood-pressure, and this fall, by

depriving the cardiac muscle of its excitant, is one of the causes of the arrest of the heart. Evenhoff (*Vratch; Union Méd.*, July 11, '97).

The principal danger from chloroform anæsthesia is the sudden syncope from cardiac paralysis, which is as likely to occur in strong as in weak subjects; it happens more frequently at the beginning than at the end of anæsthetization, presents conditions of the greatest difficulty for treatment, and frequently results in death. In view of these conditions, although the superiority and greater convenience of chloroform in certain cases of cerebral surgery, operations on the respiratory passages, etc., may give it preference, its adoption as a routine anæsthetic ought to be condemned. *Editorial (Boston Med. and Surg. Jour.*, Aug. 26, '97).

Out of some 2400 patients who were etherized, 10 developed temperatures with some respiratory complications, and all had gas before ether. Six of these had bronchitis, 1 pleurisy, and 3 bronchopneumonia, 1 of these last being a fatal case. Seven of these cases occurred in summer. In none of these 10 cases was there previous history of bronchitis; all were in good condition and took the anæsthetic well. The operations were prolonged ones, and with 1 exception on the trunk, necessitating bandaging, which would prevent free expectoration. A number of patients in bad condition from alcohol or sepsis, and subjected to short operations under ether without gas, did not develop any lung complication. These last patients, however, did not have to traverse corridors. Not one out of 600 chloroform cases, of which many were for mouth operations, developed any respiratory trouble.

Chloroform is recommended for all long operations on the trunk, or, if ether be given at first, it should be changed after a time for chloroform. *Crouch and Corner (Lancet, May 24, 1902).*

The heart also shares the brunt of responsibility with the respiratory tract as far as contra-indications are con-

cerned; but if the operator bears in mind the fact that, the nearer muscular integrity of the organ is discerned, the greater the safety, he will at once have a key to the lesion which may prove the basis of complications. Fatty degeneration and dilatation are the main conditions to fear, because the cardiac walls are the most compromised and may not be able to resist the engorgement resulting from increased arterial pressure.

Valvular lesions only increase the danger if they are obstructive. In that case, even, compensative hypertrophy may also compensate for the extra resistance induced.

In aortic insufficiency, as emphasized by Giffen, it is necessary to study heart-rhythm and arterial pressure. So long as the rapidity of the heart's action does not disturb the rhythm—viz.: first sound, second sound, pause—within reasonable physiological limits, or, in other words, the arterial pressure (composed of the time [rapidity] and intensity [muscular impulse]) does not overcome rhythm, the anæsthetic can be given without increased danger.

Physicians and surgeons are agreed that accidents in chloroform anæsthesia are not more frequent in patients with aortic or heart disease than in patients with other illness. Nor does cardiac or aortic disease contra-indicate chloroform as an anæsthetic, if the disease is not acute and infectious, if the patient is not too feeble, or if dyspnoea, asystole, or symptoms of pericardial symphysis have not appeared. In some cases of atheroma and cardiac disease the heart condition even improved after chloroformization. The main contra-indication to chloroform in patients with heart disease is the presence of dyspnoea. This is, however, but temporary. Accidents may be due to impure chloroform, its method of administration, or to errors of the anæsthetist. Rarely there may be an idiosyncrasy to chloroform, more fre-

quent in nervous patients. Death may occur under chloroform, yet may not be due to the chloroform. The question whether ether or chloroform is to be preferred as the anæsthetic has not yet been definitely settled. Ether is to be preferred in nervous patients, with kidney disease, low arterial tension, profound anæmia, and depression. It is contra-indicated in pulmonary disease, dyspnœa, etc. Ethyl bromide has been given first by Richelot with success, following with chloroform after anæsthesia has begun. Laborde advises atropine, morphine, and sparteine, hypodermically, before chloroformization. Pure chloroform, well given, to a patient prepared for it, almost never kills. Henri Huchard (*Jour. des Praticiens*, May 31; *Phila. Med. Jour.*, Sept. 13, 1902).

Disorders of the respiratory tract are as liable to compromise the issue as any grave cardiac disease. Great caution should be observed in the administration of chloroform in all asphyxial conditions,—*i.e.*, when the respiratory area is to any degree restricted through the presence of growths, pyæmic accumulations, emphysema, etc. In scrofulous children the presence of enlarged bronchial glands is to be surmised, and the anæsthetic should be administered with unusual care. In affections complicated by liquid effusions, however, the danger may be thwarted when it presents itself.

Case showing what timely evacuation of contents of pleura will do in such cases. As soon as evidences of asphyxia showed themselves the skin was divided with one cut of bistoury and the pleura was instantly opened and pus evacuated, the almost moribund patient quickly returning to life. Guérmonprez (*Jour. des Sciences Méd. de Lille*, May 4, '95).

Fatal accidents during administration of chloroform are especially liable to occur in persons with the lymphatic condition, enlarged thymus, etc. F. Strassmann (*Berliner Klinik*, Feb., '98).

Langlois and Richet have shown by experiments on animals that in surgical

anæsthesia extreme care should be taken that the movements of expiration be not interfered with. This might be extended to expiration, likewise, and the necessity of protecting the *via vitæ* against the ingress of mucus, saliva, blood, etc., thus emphasized.

Following remarks founded on 6657 administrations of anæsthetics at London Hospital. Other things being equal, the stronger the patient, the more trouble with the anæsthetic. Deaths from chloroform are more common in the middle period of life, and more men than women die from this agent. Chloroform is more dangerous during the early stages of administration; respiration should be carefully watched, and every breath should be both heard and felt. Watching the chest or abdomen is a fallacious guide. Obstructed breathing is best relieved by unblocking the teeth and pushing the jaw forward. There were 13 cases in the 6657 administrations in which the threatening symptoms occurred. When dangerous symptoms arise during or after the use of an anæsthetic, one or more of four factors may be responsible: first, the anæsthetic itself; second, the condition of the patient; third, the posture of the patient; and, fourth, the surgical operation. W. Hewitt (*Lancet*, Feb. 19, '98).

Attention has been called to the importance of examining the urine, especially for albumin, before subjecting a patient to a general anæsthetic, and particularly in subjects of middle or advanced age, whose appearance suggests the presence of renal disease. Whether the presence of albumin in the urine should prohibit any surgical operation is a mooted point. Snow laid it down as an axiom that, if an operation must be performed, however serious it might be, the administration of an anæsthetic was justifiable, on the whole, and that rule has been pretty generally adopted without any manifest bad results. Benjamin Ward Richardson, referring to the above, stated that he had administered ether,

chloroform, and methylene to great numbers of persons suffering from albuminuria, without any untoward results.

The marked increase of albumin noted in albuminuric cases and the presence of it in cases which had not shown any before the administration of the anæsthetic shown in the following abstracts, nevertheless counsel prudence.

It seems obvious that renal lesions can but cause increased blood-pressure, and thus tend to enhance the likelihood of cardiac syncope, and that, when kidney lesions are known to exist, chloroform should be administered with unusual precaution.

The urine of one hundred male patients studied before and after chloroform narcosis. The alteration of the kidney is a tissue-lesion which removes the power of inhibiting the loss of serum-albumin, the causes of which lie in the poverty of oxygen in the blood, the destruction of blood-corpuscles by the chloroform, the injury to the tissues by the liberated chlorine, and, lastly, the lowering of blood-pressure. As evidence for the occurrence of a tissue-lesion, the fact was adduced that in 44 out of 56 cases investigated upon this point, after narcosis, the urine contained nucleo-albumin. V. Friedländer (*Viertel. f. ger. Med., Dritte Folge, B. 8, Supplement, H., p. 94*).

After prolonged chloroform narcosis in healthy persons there is prolonged disturbance in metabolism of albuminous substances. Kast and Mester (*Zeit. f. klin. Med., vol. xviii, '95*).

Result of a study of two hundred and fourteen cases of chloroform anæsthesia in which the urine was carefully examined. Albuminuria occurred in 80 per cent. of the cases, lasting from two to six days. Sugar and acetone were never found. In 60 per cent. casts were present, mostly hyaline, but also a few epithelial and granular. All degrees of changes were found in the kidneys, from single hyperæmia and capillary hæmorrhages to extensive coagulation necrosis

of the renal epithelium. K. Ajello (*Monograph, Milan, '96*).

Examination of the urine in 130 cases of anæsthesia,—60 from ether and 70 from chloroform. In 8 cases out of 13 in which there was albumin in the urine before the anæsthesia there was an increase of the albuminuria: 4 times after ether and 4 times after chloroform. Eisendrath (*Deut. Zeit. f. Chir., B. 40, '96*).

Effects of ether and chloroform narcosis on the kidneys. In 29 per cent. of the cases after etherization albumin was found in the urine, and in 18.89 per cent. after chloroform narcosis. In each case the urine before the operation was free from any trace of albumin. The etherized animals showed renal alterations consisting of diffuse hæmorrhagic nephritis, with preponderating glomerulitis and multiple renal hæmorrhages. The superiority of ether over chloroform from the point of view of safety is shown. Babacci and Bebi (*Il Policlin., May 1, '96*).

Examination of the urine of 54 people after chloroform anæsthesia, and of 41 cases after ether anæsthetization. Narcosis in chloroform cases lasted, on an average, 57 minutes, and in the ether cases one and a half hours. There were 10 cases of albuminuria and cylindruria after chloroform; 15 cases after ether. In 3 of this last series there was pre-existing kidney disease. Autopsy in 2 ether cases showed hæmorrhagic nephritis affecting especially the glomeruli. Albumin is more frequently observed in the urine after ether than after chloroform, but the nephritis caused by ether is transitory, while that due to chloroform is likely to become chronic. Legrain (*Ann. des Mal. des Org. Génito-Urin., No. 2, p. 191, '97*).

Permeability of the kidneys after chloroform narcosis tested with solution of rose aniline. As a rule, it took twenty-four hours to get rid of all traces of the pigment, the patient having, as far as was known, healthy kidneys. In every case elimination was delayed by chloroform anæsthesia; while it took thirty-five hours to eliminate the pigment before chloroform, in one case it required forty-one hours after-

ward. No constant relation between the quantity of chloroform and duration of the anæsthesia and the alteration in renal function could be detected, as the personal equation of the kidney varies so much. The quantity of urine after chloroform narcosis was, for the most part, reduced. Benassi (*Gazz. degli Osped.*, Mar. 3, 1901).

If pieces of kidneys taken from an animal that died from chloroform are hardened and fixed by proper reagents, the border of the epithelial cells in the convoluted tubes is destroyed. This is of extreme importance, as the border of the epithelial cells is to the kidney what the rods and cones are to the eye, which being destroyed will render the eye blind. The kidney therefore losing that border can no more serve as a filter. The integrity of the epithelial cells is absolutely indispensable for a good function of the kidneys. Twenty-five years ago Heidenhain attributed to those cells the property of eliminating urea. We know now that the function of the cells with their intact border is secretion. They extract from the blood certain products. The renal secretion will therefore depend upon the integrity of the cells of the tubules. This important function is impaired by chloroform, when administered as an anæsthetic, but the cell is capable of recuperating. Renaut (*Jour. des Praticiens*, No. 15, 1902).

The inhibiting influence of chloroform narcosis upon general metabolism has been considered as a prominent factor in the etiology of untoward phenomena, and Guthrie and Kiefer have ascribed some deaths occurring some days after the administration of the anæsthetic to defective elimination of excretory products. Casper, Behrend, Langenbeck, and other authorities have shown that chronic chloroform poisoning does actually occur; and Guthrie ascribed to autointoxication: either a fatty condition of the liver (and, therefore, functional disturbance of the organ) existing before the anæsthetic was given, or to chloroform and operation-shock com-

bined, which aggravated the condition already present. It is supposed that lessened oxidation, such as some believe ether and chloroform can cause, leads to deposition of fat in the liver and elsewhere, and so would prevent fat being oxidized on its way from the liver into the general circulation.

Chloroform decomposes blood in presence of an alkali and liberates carbonic monoxide; also in the body in alkaline blood. This may account for some deaths from chloroform. Desgrés and Nieloux (*Jour. of Amer. Med. Assoc.*, Jan. 29, '98).

Chloroform may cause death several days after administration, from causes which are at present unknown. The changes found in such cases after death chiefly consist in fatty degeneration of the heart-muscle, of the liver, and of the kidneys. The degeneration, although usually present in several of these organs, is more often specially localized in one or other; the resulting clinical features vary accordingly. The degeneration in question is analogous to that observed in animals dying from long-continued chloroform anæsthesia. Salen and Wallis (*Centralb. f. Chir.*, Aug. 19, '99).

Ungar, Strassmann, and other observers have also found that fatty changes could be induced in the liver through the influence of chloroform upon the blood-vessels and tissue-cells. As a result, the urine becomes loaded with alkaloidal bodies which the kidneys cannot eliminate with sufficient rapidity. Hence the autointoxication.

As a result of chloroform narcosis there are present fatty degeneration of organs, especially fatty infiltration of the liver and fatty changes in the cardiac and skeletal muscles, kidneys, and stomach; these fatty changes arise from the action of chloroform upon the blood-corpuscles and tissue-cells. Some subjects show a greater susceptibility to these effects of chloroform than others. Chloroform is contra-indicated in all cases of fatty liver: whenever this condition is not discoverable by clinical evidence, the fact that the liver-function is hampered

—as shown, for example, by alkaloidal bodies in the urine—should be taken as contra-indicative to chloroform. Ungar and Strassmann, Thiem, and Fischer (*Deutsche med. Zeitung*, p. 4, '89); Ostertag (*Virchow's Archiv*, vol. cxviii, p. 2).

After death from chloroform there is a decided acid reaction of the fluids and tissues, and the lessening in alkalinity actually occurs during chloroform inhalation. Taken in connection with the researches of Kast and Mester, showing that fatty degeneration follows prolonged inhalation, this possibly explains the lethal effects that chloroform exerts on the cells. The urine, further, has its acidity increased after chloroform. It would appear as if the acid excretions of the working-muscles, etc., usually readily neutralized by the cells (Langendorff), are left unaltered, or are imperfectly neutralized during chloroform inhalation. Mansfelde (*Omaha Clinic*, Sept., '92).

Method of Administration.—Position.

—The position of the patient bears an important influence upon the results. When the splanchnic vasoconstrictors are paralyzed by injuries or poisons, such as chloroform, the influence of gravity becomes manifest, as shown by Leonard Hill, owing to dilatation of the abdominal veins with corresponding emptying of the heart and cessation of cerebral circulation; hence the numerous accidents reported witnessed in the dental position; that is to say, that employed by dentists for the removal of teeth. Death in sitting posture occurs from sudden cessation of the heart's action, through abdominal engorgement and depletion of cerebral vessels.

Two cases in which, through extensive injuries of cranium, large areas of brain proper were exposed. Under prolonged anæsthesia, chloroform reduced cerebral circulation. In one case in which the local hæmorrhage was severe the latter subsided as soon as patient was fully under anæsthetic. Bedford Brown (*Ther. Gaz.*, Dec. 15, '94).

The use of chloroform and ether is always dangerous in ordinary dental surgery, and is unjustifiable. Nitrous-oxide gas is, by far, the best dental anæsthetic. H. Sewill (*Archives of Otology*, Dec. 8, '94).

For operations about the mouth or throat full extension of the head upon the trunk, while the patient is lying down, answers admirably, but, as shown by Buxton, it produces some congestion of the head and neck vessels, which in certain subjects induces a very undesirable amount of bleeding. If the extension is not exaggerated, however, and if the head is supported beyond the edge of the table so that the traction upon the anterior portion of the neck through an excessive extension is not too great, the abnormal bleeding can be avoided. For the removal of adenoid vegetations this position is of value. In the illustration shown herewith, while the general position of the patient is, on the whole, the proper one, the head is unduly forced downward. A small pillow or three or four towels adjusted to the edge of the table to support the head somewhat higher would place the patient within easy reach of the surgeon and at the same time avoid the danger of excessive bleeding.

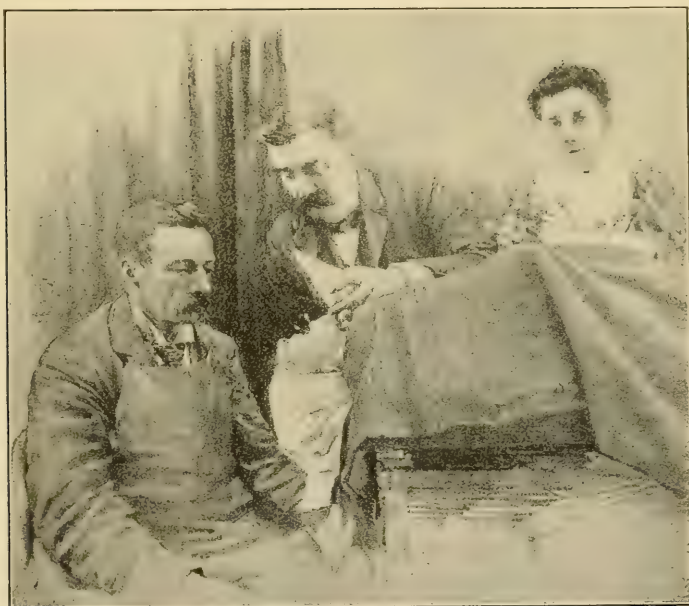
For operations in the vault of the pharynx, as in the case of adenoid growths, the blood is thereby prevented from flowing in the direction of the larynx: an element of danger, in many cases, when the position of the body is on a line to that of the region operated upon.

Dudley Buxton calls attention to the fact that the lateral position, recommended by many, is by no means possible in stout persons, while short-necked subjects also bear this position badly. He prefers to place a pillow well under

the shoulders, giving just sufficient extension of the head upon the trunk for practical purposes. This position I have found a most advantageous one in operations about the posterior nasal space.

A certain amount of care must be taken when the head is not fully extended, however, that the tongue, during the deep stage, be not allowed to fall back against the pharynx and thus tend to occlude the respiratory area.

the surrounding air as a cause of danger. When the air is surcharged with moisture the chloroform condensation in the pulmonary air-cells and its subsequent entrance into the blood are impeded; the stages of narcotism will, by this, be prolonged. Recovery is also slower. Syncopal attacks in a moist atmosphere are more likely to terminate fatally. Again, the moisture which should escape from the air-passages cannot do so when



Position for the removal of post-nasal growths. (*Kendal Franks.*)

(*Dublin Journal of Medical Science*, March, '95.)

Howard, in 1888, showed that the most effectual way of opening the air-passages was by forced extension of the head upon the trunk, thereby raising the epiglottis and tongue; but this does not prove true unless excessive extension be resorted to; and, as this is inadvisable, the benefit of Howard's method is not obtained.

Influence of Atmospheric Conditions.

—Benjamin Ward Richardson attached much importance to the condition of

the atmosphere is too saturated, and the tendency to waterlogging of the lungs under chloroform is increased.

The temperature also bears a marked influence when it is high, the volatilization is more rapid, its diffusion and condensation are increased, and both the onset and the recovery are more rapid. The safest temperature is 60° to 70° F.; a higher rather than a low range is best.

Chloroform anæsthetization under varying atmospheric pressures: The action of chloroform is more rapid but less lasting if the atmospheric pressure is reduced. The elimination of chloroform by the lungs is much more rapidly effected in animals subjected to very low pressures. Benedicenti (Archives Ital. de Biol., vol. xxiv, No. 3, '98).

In India the mortality from chloroform does not exceed 1 in 8000 cases, and in some of the largest institutions it is less than 1 in 20,000 cases. Safety does not appear to be related to any special constitutional condition of Indian races and but little to their habits. It is probably due entirely to the warm atmosphere, which favors the rapid action of the drug and its rapid elimination. To obtain similar safety in England, it would be advisable to operate in well-ventilated rooms, with a temperature not below 70° F. Anæsthesia should be produced gradually, with the chloroform diluted with plenty of air. Arthur Neve (Brit. Med. Jour., Nov. 5, '98).

Preparation of the Patient.—The patient should be in an entirely-loose garment and in the recumbent position. A quiet, well-ventilated, and well-lighted room should be selected.

Any foreign body, such as false teeth, tobacco, or any accumulation of mucus, should be removed from the mouth, naso-pharynx, and nasal passages.

All solid food should have been withheld for at least four hours and no liquid food for at least two hours before the administration of the anæsthetic, although a small quantity of brandy or whisky may be given a few minutes before if the patient be at all debilitated.

[This recommendation is of the greatest importance; for the regurgitation of food when the patient is under the anæsthetic may, by entering the larynx, cause asphyxia. SAJOURS.]

The patient's fear should, as much as possible, be allayed by kindly and encouraging words, death being sometimes

caused by heart-syncope, resulting from fright. A show of surgical instruments should be avoided.

Mental factors may be influential causes in the production of chloroform-death. Fear and anxiety may cause profound circulatory disturbance, and this condition may predispose to danger when an anæsthetic is given. In such cases an hypodermic injection of morphine should be administered, and ether should be employed instead of chloroform if there is no contra-indication. Robert Ballard (Lancet, May 7, '98).

If the operation is at all to be prolonged or be of such a nature as to cause severe pain in the waking state, an hypodermic injection of morphine, $\frac{1}{4}$ grain, should be administered twenty minutes before the chloroform is given.

Administration and Dose.—As in the case of other agents, it is obvious that the purest chloroform obtainable should be employed. Many instruments were devised for the purpose of administering anæsthetics in general (the principal ones will be described under ETHER), but these are seldom employed outside of hospitals. Except under certain conditions, when the anæsthetic is administered in the presence of gaslight, the simplest way to apply chloroform is on a towel or handkerchief; or a cone or funnel may be made with a folded towel into which the anæsthetic may conveniently be dropped.

On account of its irritant action, chloroform should not be allowed to come into contact with the eyes or face. In the case of a fair-skinned female patient, it is advisable to apply vaselin or cold cream where the chloroform-vapor is likely to touch the skin.

A drop-bottle should be employed for the anæsthetic, the pouring-out method usually employed being a dangerous procedure.

The patient lying upon his back, his chest is bared, a compress placed over his mouth, and 2, 3, or 4 drops of chloroform poured upon it. The compress or cone is held so as not to close completely the nostrils and mouth, thus enabling the patient to inhale well-diluted vapor at first. In fifteen seconds the chloroform will have evaporated, when 4 or 5 drops more are then allowed to fall on the centre of the compress, this being turned rapidly so as to avoid an excessive intake of fresh air. This manœuvre is repeated about every half-minute. When narcosis is complete, 2 or 3 drops of the anæsthetic are used every minute. Coughing indicates that the air inhaled is too heavily charged with chloroform, while struggling in the first stage tends to show that the patient is feeling the want of air—a terror-inspiring sensation.

The extreme danger of rapid chloroformization was repeatedly emphasized by Richardson, who argued that fatal results follow upon the sudden impact of chloroform—an irritant vapor—upon the nervous periphery of the breathing-surfaces. (See influences upon the nasal mucous membrane, *infra*.) This sudden impact causes, in his opinion, a contraction of the pulmonary arterial vessels; thence results ischæmia of the lungs and overfilling of the right heart, leading to cardiac stand-still. A few minims of chloroform injected into a vein kills the heart-muscle outright and beyond recovery. If the animal is healthy the lungs prevent such a catastrophe when the chloroform is inhaled; but the author contends that when the heart is not healthy the lethal dose may be so small that it may pass through the lungs and reach the heart, causing fatal syncope. While gradual, rather than rapid, chloroformization (two minutes for infants,

three for children, and four or five for adults—Snow) is recommended, the danger is urged of overcaution, as the blood grows highly saturated with chloroform before anæsthesia is obtained, and the organs and tissues are so saturated with chloroform that, should any causal accident arise, it is fatal in spite of all efforts to withdraw the chloroform from the blood, since reabsorption into the blood takes place from the tissues.

To settle this question Kionka conducted a series of researches to determine quantity of ether or chloroform necessary to produce narcosis. He found the dose required to be relatively small. Narcosis was obtained when the air contained from 0.15 to 1.3 per cent. of chloroform, or 2.1 to 7.9 per cent. of ether. The minimum quantity of ether necessary to produce anæsthesia could be greatly exceeded without endangering life, and narcosis could be prolonged by using the same dose, while, under similar conditions, chloroform invariably caused death of the animal. Sleep under ether, when once established, could be maintained with a smaller dose than that required to produce it. From the beginning chloroform caused early arrest of heart and respiration.

Robert Bell has noted that the symptoms of approaching danger under chloroform always appear in the following order: (*a*) coughing, (*b*) gasping, (*c*) choking, and (*d*) struggling. If, at the first appearance of coughing, the vapor is given more diluted, no further difficulty will arise. On the other hand, W. A. Parker ascribed the small number of deaths observed in Scotland to the fact that the anæsthetists are not afraid of chloroform; they use it fearlessly in unstinted doses, pushing the patient rapidly under.

Buxton states that there seems every

reason to believe that an overdose of chloroform may be arrived at in one of two ways: (1) a sudden intake of a lethal dose, which, according to Sansom, who followed Snow's emphatic teaching, may be taken when even a small quantity of the anæsthetic is thrown on lint or a towel, or (2) through accumulation of the drug in the body. This commonly shows itself by paralyzing the medullary centres and so producing cessation of respiration. Impairment of *expiration* is the most usual cause of this, due in many cases to some mechanical cause, such as emphysema, falling back of the tongue, sucking in of the lips, or blocking of the air-ways by mucus or blood.

As regards the lower mortality reported from Scotland, Buxton argues that many deaths under chloroform have occurred in that country; even as early as in the days of Simpson. As no public investigation is held corresponding with coroners' inquests, as is the case in England, no report gets into the public press. He reaches a conclusion sustained by experience, and verified by a wide-spread review of the literature, to the effect that *every individual requires a specific dose: the drunkard and athlete require much; the pale, frail, anæmic woman very little.*

The stages of chloroform narcotism as given by Snow and Buxton are divided into four:—

The *first* stage, from the commencement of inhalation to the loss of conscious control of the limbs.

The *second*, to the stage of loss of conjunctival reflex and rigidity of the muscles.

The *third*, or surgical stage, when the muscles are relaxed (in the main), the corneal reflex is lost, and the pupil is contracted.

The *fourth* stage, when the medullary

centres are affected, the pupils dilate, the respiration gradually fails, the muscles are absolutely relaxed, the sphincters cease to act, while the circulation fails.

Beyond this stage convulsions occur, the breathing ceases, and the heart and circulation come to a stand-still. The complete relaxation of the muscles can, in some cases, be arrived at only by the patient's entering the fourth stage, and, in the case of chloroform, such pushing of the anæsthetic can only be accomplished by seriously jeopardizing the patient's life. In the case of ether, however, a patient can, with ordinary care, be allowed to pass into this stage without danger.

At all times during the administration of the anæsthetic the respiration and the circulation should be simultaneously watched.

Untoward Effects.—The chances that no trouble will be met with stand as 1500 does to 1, provided average care has been taken in determining whether the case be not one offering unusual chances against a successful administration. But in *all* cases certain allowances must be made not only for previously-undiscovered elements which may suddenly bear their influence upon the issue, but also for known conditions which also modify the form of issue.

Owen states that there is always risk in giving chloroform or any other anæsthetic to a child; but this risk is diminished in proportion as the vapor is administered in a careful manner and by a well-instructed person. It is important to bear in mind, in this connection, that the general impression that children very rarely succumb to the influence of chloroform is erroneous. The many deaths in children ranging from early infancy to 15 years of age have served to emphasize this fact.

On the other hand, the fear that untoward results will follow the use of an anæsthetic in patients of advanced age is equally exaggerated, as shown by a large series of cases reported in which no unusual effect was witnessed. Heath, for instance, administered chloroform to a woman 94 years old, to reduce a dislocation. The patient bore the anæsthetic calmly and easily. Indeed, acute suffering is a prolific source of fatal shock in old people, and anæsthesia thus becomes a life-saving agent in them.

As regards the increased liability to untoward effects through disease, Reynier recently showed that, according to the more or less great resisting power of the various cells affected during the anæsthetization, are fatal accidents liable to occur. While in alcoholics, whose cerebral cells are in a continual state of hyperæsthesia, delirium is observed, which may reach the stage of delirium tremens; but in these, also, heart-wall degeneration is probable, and early syncope is likely in proportion. In hysterical subjects all varieties of hysterical attacks may occur, even paralysis and syncope. The same is the case in epileptics. In morphinomaniacs only slightly intoxicated chloroformization is easily and rapidly accomplished; in others, on the contrary, it is more dangerous. In ataxic subjects the period of medullary excitement nearly always gives rise to reflexes which may arrest the respiration and heart-movements.

To these morbid conditions must be added those enumerated and involving the circulatory, respiratory, and urinary systems, and prolonged abdominal operations, strangulated hernia in old and exhausted subjects, colotomy and colectomy, etc.

Extra watchfulness should be observed in *all* such cases, and shock anticipated

by preliminary measures: stimulants, strychnine, etc.

Shock. — Murray-Aynsley emphasized the fact that many deaths under chloroform occurred within a very short time after the commencement of inhalation, or when comparatively trifling, although painful, operations were to be performed (extraction of teeth, etc.) were due to *shock* during *imperfect anæsthesia*. He denies that the experiments performed by the second Hyderabad Commission prove that shock under chloroform was not competent to produce syncope, as in them painful operations were performed on animals coming out of chloroform, and in a condition where, as he contends, analgesia persisted, although anæsthesia was imperfect.

Closely connected with the production of shock is *fear*, which tends greatly to increase the chances of cardiac syncope, through the exaggerated functional tension induced. White has shown that even a small amount of chloroform is capable of inducing a fatal issue under these circumstances. There is a marked difference in this particular between Europeans and Hindoos: a fact which has served to markedly decrease the mortality of anæsthesia in India.

The letters which are constantly appearing in current medical journals indicate very plainly the views which are held in this country on the vexed subject of chloroform *versus* ether as an anæsthetic, but less is generally known of the opinions of the profession in America on this matter. It might perhaps be hastily assumed that in the United States, the home of anæsthesia by ether, no other drug, and least of all chloroform, would be habitually used. To those who are of this opinion the statements made by Dr. J. A. Bodine, Adjunct Professor of Surgery at the New York Polyclinic, will come as a

surprise. In a recent lecture he admits freely that chloroform possesses many advantages over ether, but points out that the administration of the former has been followed by a considerably larger proportion of deaths from the anæsthetic than when the latter was employed. He thinks, however, that this unfortunate fatality might be offset to some extent by the deaths which take place some time afterward, from kidney irritation and lung involvement after ether.

He contends that most chloroform deaths are due to vasomotor paralysis, and that deaths from fright occur just in the same way. Two instructive and suggestive cases are cited. In the first, the patient, a very nervous individual, became so frightened before the operation that the rhythm of his breathing was seriously disturbed; the anæsthetist, in consequence of this, gave him some preliminary training in deep breathing before the administration of the chloroform; the cone was placed over his face, and he was told to breathe deeply; after a few gasps he ceased to breathe and could not be resuscitated. Not a single drop of chloroform had been administered. In the second case, the patient, who was also a very nervous man and very fearful of the result of the operation (for hæmorrhoids), was given an enema before any anæsthetic was administered; he thought this was the first step of the operation, ceased breathing, and died. In both these cases the necropsy revealed no morbid state except the tense abdominal veins, in which nearly all the blood of the body had collected as a result of the vasomotor paralysis consequent upon the fright.

Dr. Bodine, therefore, concludes that fright may be an element in the production of death in cases in which chloroform is used. He states that seven out of every ten deaths reported from chloroform anæsthesia occur during the preliminary stage, when only a few drops up to a drachm have been given. There is negative evidence also in the fact that in obstetrical practice chloroform is the anæsthetic of choice; this is due to al-

most complete absence of a chloroform mortality during labor. As an explanation of this freedom from danger we have the circumstance that women are not fearful about the anæsthetic in their confinements, but ask freely for it. Children, also, are not frightened as adults are, and consequently suffer little from chloroform as an anæsthetic. Dr. Bodine refers, in addition, to the interesting fact that the negro of the Southern States stands chloroform very well; he has a child-like faith in his physician and does not fear any of the measures that he may adopt. Yet the negro may die from fright, as a graphic story of a student trick told by the writer proves.

The conclusion is, therefore, reached that we must, for the safe administration of chloroform, eliminate fright. Dr. Bodine tells his patient to put his hands tightly together, the fingers interlacing, and to grip them firmly; he asks him to fix his mind upon that action, to listen to the voice of the anæsthetist and to do what he tells him, and to breathe deeply and quietly and not to mind the sensations which come over him. General conversation in the neighborhood of the patient should not be allowed. The writer, in conclusion, thinks that if deaths from fright could be eliminated, chloroform would be a much safer anæsthetic than ether, and says: "If I had to choose an anæsthetic for myself to-morrow, I should take chloroform, but I should want it administered by a careful expert anæsthetist."

These views, although perhaps optimistic, are well worthy of being kept in mind by the profession on this side of the Atlantic. Editorial (*Brit. Med. Jour.*, Feb. 21, 1903).

Too prolonged a fast prior to taking chloroform is considered dangerous by Murray-Aynsley. Christopher Heath, when an operation is likely to be very prolonged, administers an enema of hot beef-tea, half an hour before the administration. Silk has recommended the "hospital regimen" for some days before the operation.

Stimulants were advocated even by B. W. Richardson, who gave alcohol in definite doses, twenty minutes before the inhalation.

Formula:—

R Tinct. chloroformi, 1 drachm.

Spir. tenuior, 1 ounce.

This was given in water and sweetened if preferred.

Foxwell also gave alcohol when the heart was not orderly and calm five minutes before beginning the administration of the anæsthetic, but opium, given two or three hours before, he considered even better.

Too little importance is usually attached to *struggling*, which, according to Lawrie, is produced (1) by fright, leading to purposeful resistance; (2) by choking or asphyxia from overconcentration of the vapor, owing, generally, to the cap being held too close to the face at first or afterward when the chloroform is being renewed; and (3) by intoxication,—i.e., the so-called “struggling stage.” Dudley Buxton considers the struggling of intoxication as extremely dangerous. The breathing is then irregular and the amount of chloroform in the circulation is considerable, anæsthesia being nearly complete: factors markedly increasing the chances of cardiac syncope and general toxæmia.

The inhaler should be removed from the face for a few respirations, which does not necessarily cause a break in the narcosis, as chloroform still remains in the air-cells; and, as soon as respiration has resumed its normal character, the chloroform is reapplied.

Certain regions are especially prone to encourage cardiac syncope when submitted to *rough handling* in surgical procedures. Traction upon the omentum and undue manipulation of the intestines

and other viscera are probably the most active factors of this kind. Operations upon the anus have also shown a tendency in this direction. Operations that would be attended by great pain without an anæsthetic seem to show the greatest tendency to produce cardiac failure.

The part played by reflex action in the production of syncope has not as yet received much attention. Laborde, some years ago (1890), observed that the heart of the monkey was immediately arrested by the irritative action of chloroform-vapor on the nasal distribution of the trigeminus, and observed that the application of a solution of cocaine to the nasal mucous surfaces prevented the untoward result. Recently Rosenberg, Guttman, and others have utilized this prophylactic measure during surgical anæsthesia, and have lauded its merits.

The vapors of this drug are able, by their irritating action upon the nervous elements within the naso-pharyngeal mucous membrane, to determine a brusque arrest of the heart and respiration. This paralysis occurs, moreover, very easily if the subject be put under chloroform during a state of very great excitement. In order to prevent as far as possible this cause of death, which is always imminent, as soon as one approaches the nose of a sick person with a compress soaked with chloroform it is necessary to decrease the unnecessary excitement of the patient and the susceptibility of the terminal expansion of the fifth cranial nerves. The best means, according to the author, of accomplishing this purpose consists in giving a preventive injection consisting of hydrate of morphine, 0.10 gramme; sulphate of atropine, 0.01 gramme; sulphate of sparteine, 1.00 gramme; distilled water, 10 grammes, to every individual to be chloroformed. Irrigation of the nasal mucous membrane and of the pharynx and glottis with a concentrated solution of cocaine is also of great benefit in suppressing the susceptibility of these re-

gions. It is also necessary to have care to keep the tongue forward in the mouth with special forceps during the entire duration of the chloroformization, thus avoiding a sliding of this organ backward over the orifice of the glottis, thereby provoking asphyxia, and being ready to carry out rhythmical traction on this organ in case unfavorable symptoms arise. Laborde (*Medical News*, July 5, 1902).

One hundred and twenty experiments to ascertain the part played by vagus inhibition in chloroform poisoning. In 54 cases vagus inhibition embarrassed the circulation to a more or less dangerous extent, and in 33 experiments was the immediate cause of death. To sum up: 1. A heart which has been poisoned by inhalations of chloroform of a strength of 2 per cent. and upward can always be permanently inhibited by stimulation of the vagi with the faradic current when the blood-pressure has fallen to about 40 to 50 millimetres of mercury pressure. 2. Chloroform raises the excitability of the vagus mechanism, particularly in the early part of the administration. 3. The increased excitability of the vagus mechanism is due to the action of chloroform on the vagus-centres, and the inhibitory action is more intense from being exercised upon a heart whose spontaneous excitability is diminished by the action of the chloroform upon it. 4. Chloroform administered to morphinized dogs in air containing not more than 1.5 per cent. of the vapor, after a period of mild excitation slowly depresses vagus excitability. The excitability may again be raised with more or less readiness according to the duration of the administration and the endurance of the vagi by increasing the percentage strength of the chloroform or by asphyxia. 5. Vagus inhibition is, in dogs, the great factor in the causation of sudden death from chloroform. 6. Dangerous inhibition is liable to occur whenever the strength of chloroform in the air inhaled rises above 2 per cent. E. H. Embley (*Brit. Med. Jour.*, April 12, 1902).

Raul has traced chloroform deaths to reflex paralysis of the tongue and neigh-

boring parts, while Vallas considers primary syncope, due to laryngeal reflex, as one of the usual modes of death when chloroform is employed.

We have, in the production of asthma through intranasal pressure, distinct collateral evidence of the nervous relationship existing between the upper and lower respiratory tract, and, in the recurrent branch of the pneumogastric, an evident indirect association between the larynx and the heart, to say nothing of the sympathetic system, which plays the most important rôle in all reflex manifestations.

Symptoms of Collapse.—According to Guthrie, the symptoms are alike in all cases, and are as follow: Sudden and complete blanching of the face takes place, leaving it of a ghastly-gray hue. The term "pallor" conveys no idea of the actual appearance. The eyelids fall open, the eyeballs are fixed in the upward position, with pupils fully dilated as under extreme atropinism. At the same time the cornea becomes glazed and sticky, giving an appearance which, once seen, is never forgotten. It can only be described in a somewhat fanciful manner by saying that the light seems to fade from the eye as does the color from the cheek and lips. Probably it is due to flaccidity of the cornea from decrease of intra-ocular tension, noticed by Dubois (*Soc. de Biologie*, '84). It is the undoubted look of death.

The appearance of a person in a dead faint, or just after a severe accident, is no more than the shade of that which obtains in cases of chloroform collapse.

The pulse and cardiac impulse are at these times no longer to be felt. Respiration commonly ceases at the moment when the blanching and stoppage of the pulse occur, but at times a few feeble and irregular inspiratory gasps are subse-

quently drawn. The patient is, to all appearances, dead. Whether the heart actually ceases to beat at such times will probably never be ascertained, for the moments are too valuable to be spent in delicate investigations on this point. Neither is it possible to affirm from clinical observation that the heart becomes dilated, as in the experiments of MacWilliam and Johnson on animals. Time cannot be wasted in mapping out the area of the heart's dullness in a patient who is in imminent danger of death.

In some cases lividity, accompanied by turgescence of the veins of neck and face, immediately precedes the blanching and look of death, and is coincident with the stoppage of respiration. Possibly dilatation of the heart has actually taken place, and the condition is that of the true cardiac syncope described by Snow.

It might be objected that, were dilatation present, the cyanosis should continue, and not give place to pallor; but, possibly, as the heart fails regurgitation takes place into the inferior cava, and allows the blood from the distended veins of neck and head to enter the right heart.

In children, cyanosis, except where actual mechanical asphyxia has been produced, is less apparent than pallor. Under treatment, children almost invariably recover from these alarming conditions, whereas in adults the reverse is unfortunately the case.

Athetosis of the fingers is a premonitory sign of impending asphyxia in chloroform narcosis. Koblack (Centralb. f. Gynäk., No. 1, 1900).

As a rule, the preliminary signs of collapse are sufficiently well marked, and if observed in time many a catastrophe may be averted.

These signs are circulatory and respiratory.

The circulatory sign is the presence of increasing pallor, not amounting to absolute blanching.

Failure of respiration is marked by a peculiar type of breathing, in which expiration is extremely short and inefficient, while inspiration is sudden, forcible, and gasping, often accompanied by falling of the lower jaw, and spasmodic clonic contraction of the chin-depressors and muscles of the neck. The inspiratory gasps are irregular and broken, and occur with increasing slowness until the condition of sudden collapse ensues.

This type of breathing is precisely similar to that which is often seen in a patient dying of respiratory failure from other causes.

Under the influence of chloroform the pupil first dilates and then contracts. The dilatation of the pupil of incomplete chloroform narcosis is due, according to Arthur Ward, to mental, sensory, or sympathetic impulses affecting the semi-narcotized cerebrum, and so giving rise to reflex inhibition of the centre of the third nerve. The activity is, therefore, due to the fact that the centre itself is not narcotized. In complete narcosis the contracted pupil is due to the complete subjection of the cerebrum, while the unopposed third-nerve centre remains active, all cerebral reflexes being now barred. *In dangerous narcosis the third-nerve centre itself becoming poisoned, its action no longer controls the pupil, which dilates and grows less and less sensitive to light, while the globe becomes fixed.* This fixation of the eyeball, together with the stertor of breathing and the sluggish pupils, forms the contrast between the danger-stage of chloroform sleep and the second stage, when dilata-

tion of the pupil is associated with shallow breathing, efforts at vomiting, pupils reacting to light, and return of conjunctival and other reflexes. The period of going under is, Ward thinks, the one of most danger. The patient then, by holding his breath, debilitates the respiratory centre by cutting off its oxygen-supply, and so predisposes it to injury by any access of strength of the chloroform-vapor.

Any material dilatation of the pupils means either that the patient is coming around—pupil active and other reflexes will follow—or that the patient is getting too far under,—stertorous breathing, sluggish pupil, fixed eyeballs. In first case more chloroform; in second, drug to be withheld till contraction recurs. A. H. Ward (Cleveland Med. Gaz., Sept., '95).

The degree of narcotism present may, to a great degree, be determined by pupils. Breathing, pupil, and pulse must be watched. White (Brit. Med. Jour., Apr. 20, '95).

When breathing assumes automatic character, indicating that patient is unconscious, the amount of chloroform should be regulated by the size of the pupil; pin-point pupil is the safest sign; large pupil may mean narcosis. R. Gill (Jour. Amer. Med. Assoc., June 8, '95).

The pupil becomes smaller as the patient goes under the influence of the drug, and just enough chloroform should be given to keep the pupil a moderate size. Although the moderately contracted pupil reacts when one eye is opened, yet, when both eyes are opened, the pupils suddenly become contracted. This is the limit of the pupillary reaction to light in chloroform narcosis. A few more drops may then be added slowly; but, if he is almost awake, they must be dropped on rapidly. Adolf Floekemann (Centralb. f. Chir., May 25, 1901).

Methods of Resuscitation.—When there are indications of syncope, no time should be lost in ascertaining the degree of danger present and the most active

means, *artificial respiration* by Sylvester's method or *inversion*, while an assistant is giving hypodermic injection of $\frac{1}{30}$ grain of strychnine, should at once be resorted to.

Whether artificial respiration will or will not succeed depends, according to B. W. Richardson, upon several circumstances: (1) the time which has elapsed since apparent cessation of vital action in the lower animals, even after seven minutes' restoration has occurred; (2) a high temperature, which favors clotting in the pulmonary circulation; (3) extreme cold; (4) rough movement; (5) inept artificial respiration may give the *coup de grâce* to the enfeebled heart.

The defects usually witnessed consist in too-rapid motions, and incomplete emptying of the lungs, so as to induce rapid elimination of the chloroform.

Murray-Aynsley lays stress upon the fact that artificial respiration should not be begun by an act of inspiration; that is, by dragging the arms above the head, for such a proceeding serves to promote further absorption into the blood of the chloroform from the saturated air in the lungs. They should first be brought down close to the body; the thorax is then compressed and the arms are only elevated when the chloroform-laden air is as much as possible forced out. Care should be taken to clear thoroughly the mouth and throat of saliva, mucus, vomited matter, blood, etc., that may be present.

Wood considers "forced respiration" the most valuable plan. He employs a pair of bellows which are connected with a tracheal tube by India-rubber tubing; a face-mask is also required.

Cases in which, all the usual resuscitative measures having failed, complete inversion and suspension by the bent knees over the operator's shoulders re-

sulted in recovery. Prince (Ther. Gaz., Jan., '93).

Rapid and violent artificial respiration and overvigorous efforts in the direction of inversion, etc., may, if the heart is already deeply chloroformed, lead to a fatal distension of that organ. Leonard Hill and Barnard (Brit. Med. Jour., Nov. 20, '97).

Complete inversion—*i.e.*, suspending the patient by the feet or bent knees—is sometimes rapidly effective. Dudley Buxton regards Nélaton's inversion method as the best procedure in cardiac failure when no pulmonary or venous engorgement. In his opinion, artificial respiration stands *facile princeps* for cases of failure of respiration when due to narcotism of medullary centres.

Kelly recommends the following plan, which combines inversion and artificial respiration in an especially-effective manner: "On the first indication of failing respiration the administration of the anæsthetic should be instantly suspended and the wound protected by a fold of gauze. An assistant steps upon the table and takes one of the patient's knees under each arm and thus raises the body from the table until it rests upon the shoulders. The anæsthetizer in the meanwhile has brought the head to the edge of the table, where it hangs extended and slightly inclined forward. The patient's clothing is pulled down under the armpits, completely baring the abdomen and chest. The operator, standing at the head, institutes respiratory movements as follows: Inspiration, by placing the open hands on each side of the chest posteriorly over the lower ribs, and drawing the chest well forward and outward, holding it thus for about two seconds; expiration, reversing the movement by replacing the hands on the front of the chest over the lower ribs and pushing backward and in-

ward, at the same time compressing the chest. The success of the manœuvre should be demonstrated by the audible rush of the air in and out of the chest."

The following plan of resuscitation was pursued by Maas, and, after over an hour, in each case successfully: The mouth was opened, the tongue drawn forward, and the epiglottis raised. The præcordial region was then compressed thirty or forty times a minute (the frequency of respiration). Whenever this was stopped, syncopal symptoms again appeared. Subsequently tracheotomy was performed, as it was difficult to keep the air-passages free; but this did not assist the circulation. The respirations becoming almost imperceptible, Sylvester's method of artificial respiration was adopted, and more vigorous pressure made over the breast. A similar course was adopted in the second case. The manœuvre is thus performed: The operator stands upon the left side of the patient, and presses, with quick, strong movements, deep down in the region of the heart with the fingers of the right hand, while the ball of the thumb is placed above the left clavicle. The number of compressions is one hundred and twenty or more per minute. The left hand should seize the patient upon the right side of the thorax.

Case in a child, apparently dead, in which the König-Maas method—rapid compression (about 120 per minute) of the præcordium—followed by ultimate recovery. Seven minutes had elapsed during which neither heart-beat nor respiratory effort could be detected. Leedham Green (Birmingham Med. Rev., Feb., '95).

A method recommended by Prus is warranted when other means of resuscitation have failed. This consists in exposing the pericardium by making an opening through the chest-walls—a

trap-door flap of skin, muscles, and excised ribs—and grasping the heart and pericardium. The firmness of the grasp is then increased every second—stimulating its own normal action. Cases recently reported have shown that the heart, even in doomed subjects, may be brought to react, at least for a time.

For cases of cardiac failure the heart-muscle should be grasped and compressed intermittently by pushing the hand backward beneath the xiphoid cartilage. Hiffe (Brit. Med. Jour., Feb. 6, '92).

Case in a boy aged 15 years. After tracheotomy and prolonged attempts to establish artificial respiration, an opening was made in the anterior wall of the thorax on the left side and the pericardium exposed. Rhythmical compression of the heart excited slight movements of this organ, and pulsation was observed in the large blood-vessels of the thoracic cavity, but the respiration, in spite of strenuous and prolonged efforts to restore the action of the lungs, was not renewed, and after an interval of half an hour, during which cardiac massage was energetically and persistently practiced, the movements of the heart ceased. Aglinzeff (Centralb. f. Chir., No. 21, 1901).

Case of chloroform narcosis in a man 24 years old. Ten minutes later the trachea was opened and air was blown into the lungs, but without result. Prus's cardiac massage was then decided upon. An incision was made in the skin and muscles parallel to the third and fifth ribs and left sternal edge. The third and fourth ribs were cut close to the sternum, and two and a half inches were resected in the flap. In doing this the left pleural cavity was accidentally opened. The hand was then introduced, and the heart, with the pericardium still intact, was grasped. No movements were felt, but rhythmical compressions were systematically practiced, partly by grasping the organ and partly by pressing it against the back of the sternum. After a short time slight contractions were felt, which gradually increased, and at the end of one-half hour

spontaneous respirations were initiated. At the end of three hours breathing was deep and without effort. Four hours from the commencement of inhalation respiration became difficult, and after a few minutes ceased. The heart continued to beat from midday until 8 P.M. The temperature of the body was fairly maintained, falling slightly; after eight hours it was 98° F. Freyberger (Hospitalstidende, B. viii, No. 47; Treatment, Jan. 4, 1901).

Strychnine.—The value of strychnine as an antidote to chloroform, when given hypodermically, is insisted upon by many, and the experience of the past few years seems to corroborate this opinion. Its main object is to sustain vitality until sufficient elimination of the anæsthetic has taken place. It must be used energetically and administered hypodermically.

The great value of strychnine as a stimulant to the respiratory centre during chloroform poisoning in keeping life going while the vapor is being exhaled; but the drug must be used boldly.

The use of the electrical current in acting upon the respiratory centres at once, and by increasing the current rapidly, keeps the respiratory mechanism during the dormant stage of strychnine after injection.

With these two agents to hand one ought to be able to treat any case of chloroform poisoning. S. T. Reid (Brit. Med. Jour., Nov. 20, '97).

Hydrocyanic Acid.—This agent has been suggested by Hobday recently, but its use is not to be recommended until its merits will have been demonstrated.

Electricity.—According to H. C. Wood, attempts to excite contraction of the diaphragm by electric stimulation of the phrenic nerve are fraught with danger, the overflow of the current being likely to lead to cardiac inhibition. Rockwell, however, has reached the conclusion that the inhibiting fibres going to the heart are less affected by electric-

ity than the accelerator nerves. The beneficial effects of the faradic current are due, not to any action it has on the heart's rhythm, but to its stimulating influence over respiration.

The strength of the current employed to produce this effect on respiration is much less than need be if a cardiac stimulation is aimed at, and the application of one pole over the pit of the stomach and the other under the angle of the lower maxillary near the anterior border of the sternö-mastoid is often fraught with excellent results.

Cold.—The failure of respiration under an anæsthetic may sometimes be overcome and spontaneous respirations initiated by pouring a quantity of ether upon the bared abdomen. The cold thus produced will, says Hare, often prove successful in restarting breathing.

The well-known measure of slapping the surface with wet towels is generally utilized, but does not represent an effective procedure in serious cases.

Nitrite of Amyl.—Great reliance is placed, by W. M. Killen, on immediate use of nitrite of amyl, combined with artificial respiration. Marsh states that it is at the initial stage of heart-failure that it is invaluable. Dudley Buxton argues that whatever value nitrite of amyl may possess, it does not, he thinks, act as an antidote to chloroform. He has found it most serviceable in failure of the circulation from prolonged severe operations, in collapse, and fear-syncope.

Injections of Salt Solution.—The injection, either intravenous or hypodermically, of the physiological solution (6 per cent.) of sodium chloride has been advocated in chloroform toxæmia. The quantity to be injected depends upon the amount of blood lost during the operation.

For chloroform toxæmia the injection either intravenous or hypodermically of the physiological solution of sodium chloride is very highly recommended. Bobroff (Lancet, Jan. 9, '92).

Infusion of salt solution in heart-failure advocated. Reim (Centralb. f. Chir., Nos. 17, 19, '95).

Suprarenal Capsules.—The extract of these organs has recently been recommended owing to the powerful action of this agent upon the vasomotor system.

Conclusions reached after a series of observations made upon dogs for the purpose of testing the action of the suprarenal extract upon these animals when they have been narcotized by chloroform almost to the point of arrest of the heart and respiration: 1. The intravenous injection of the suprarenal extract is capable of saving the lives of dogs suffering from extreme chloroform narcosis. 2. Compared with the procedures of other investigators, notably those of Schüller, Laborde, and of König-Maas, intravenous injections of the extract are preferable on account of its more rapid action. 3. Extract of suprarenals exercises a marked influence upon the respiration, the blood-pressure, and the tone of the heart-muscles even in such small amounts as from 15 to 30 grains of a 1-per-cent. solution. Hence it should be borne in mind that it is a powerful remedy and should not be given in large doses. 4. During chloroform narcosis it is wise to have prepared a fresh solution of suprarenal extract, preferably sterilized by boiling, in order to controvert any sudden collapse. 5. The best results, in cases of imminent death due to chloroform, are obtained by means of combined procedures, such as intravenous injections of suprarenal extract, massage of the cardiac region, and the subcutaneous injection of physiological salt solution. F. A. Magnkovsky (Russian Archives of Path. Anat.; Amer. Medico-Surg. Bull., May 10, '98).

Two drugs which promote contraction of the arteries, and in consequence must antagonize the dangerous fall of blood-pressure produced by chloroform, are atropine and extract of suprarenal cap-

sule. Extract of suprarenal capsule increases remarkably the rate and the force of the heart-beat. Schäfer (Lancet, Feb. 5, '98).

Venesection.—This is an old measure which, nevertheless, has merit. The essential point seems to be that the veins to be opened should be as large and near to the heart as possible, in order that the issuing stream of blood should be of considerable volume and the relief to the heart as rapid and thorough as possible.

Case of arrest of the heart's action and of respiration during chloroform anæsthesia in which the internal jugular vein was opened; compression of the lower chest to relieve the distended right ventricle then resorted to. Several ounces of blood rapidly escaped, and, after the jugular had been clamped by two forceps, artificial respiration was resumed. In less than half a minute the patient made a faint inspiration, followed in a few seconds by another, and, artificial respiration being continued energetically, the heart was heard to beat, at first slowly; but soon the pulse and respirations gained in strength and frequency. The operation was now completed without further administration of an anæsthetic. This case is deemed of importance, as demonstrating that the bleeding from the internal jugular vein, by relieving the distension of the right heart, was the main factor in bringing about the recovery of the patient from an apparently hopeless condition. H. F. Waterhouse (Brit. Med. Jour., July 18, '96).

Rhythmical Traction of the Tongue.—Laborde's method has been successfully employed in a number of cases. Labbé employed it in a case in which flagellation, artificial respiration, and galvanism had been tried in vain. Verneuil extols the method, especially when alternated with flagellations of the epigastrium with a wet cloth.

After-effects.—Headache, nausea, vomiting, bronchial irritation, and hysterical symptoms frequently present themselves after the use of anæsthetics,

but less so after chloroform than after ether.

When gastric symptoms—nausea, vomiting, etc.—prevail, milk and lime-water frequently succeeds in allaying them. If they are stubborn, lavage with a lukewarm solution of bicarbonate of soda will usually master them. An hypodermic injection of morphine, $\frac{1}{4}$ grain, with $\frac{1}{120}$ grain of atropine, may be used with confidence when the means previously indicated fail.

It is a commonly observed fact that vomiting after anæsthetization is associated with a severe degree of circulatory depression and not infrequently with actual syncope. Editorial (Lancet, Nov. 10, '94).

[Several cases in the year's literature vividly sustain this point. *Ed., Annual, '96.*]

The nausea after chloroform anæsthesia will not occur if for several weeks before undergoing operation the patient will take chloroform-water so as to accustom the system to it. In order to avoid as much as possible the unpleasant taste and smell of chloroform, the following mixture may be given:—

℞ Aq. chloroform., 6 ounces.
Spir. menth. pip.,
Spir. anis., of each, 4 drops.

Filter after twelve hours. Weber (Bull. Gén. de Théor., Apr., '99).

The value of inhalations of vinegar to control nausea and vomiting after chloroform is frequently extolled. According to Lewin, the free chlorine—one of the products of chloroform and which is a marked irritant to the pharyngeal mucous membrane and induces vomiting—is neutralized by the acetic acid.

Of 174 cases of vomiting following the administration of chloroform, 125 patients were relieved by causing them to inhale the fumes of vinegar previously placed upon a towel and left over the face of the patient for a number of hours after the chloroform-mask had been removed. If the vomiting returns after

this treatment is stopped a renewal of it will be sufficient to check the relapse. Lewin (*La Méd. Mod.*; *Ther. Gaz.*, Mar. 15, '98).

Paralysis sometimes ensues. It is usually due to pressure against the edge of the table or to strained position of the members. Strychnine and electricity are indicated in such cases, with massage calculated to increase the activity of the local circulation.

Case which presented complete paralysis of right arm; still present three months after anæsthetization. Post-chloroformic paralyses generally due to compression of the brachial plexus. Franke (*La Tribune Méd.*, July 17, '95).

Case of musculo-spiral paralysis from pressure. Patient's arm pressed against an iron bar. Several similar cases have been reported. Commonest in laparotomies where operator stands at the side and the arm pulled up to be out of his way. Bruns (*Archives Clin. de Bordeaux*, Nov., '95).

Paralysis arises from several causes: First, from the position in which the patient is lying, whereby pressure is exercised upon a supplying nerve, or as a result of tractions on the arm or leg of a violent nature. Second, the employment of impure chloroform, which seems capable of poisoning the nervous system and producing such paralysis, at the same time developing transient or permanent albuminuria. Tasse (*La Semaine Méd.*, Mar. 10, '97).

Therapeutics.—The therapeutic uses of chloroform are somewhat restricted. It is an invaluable agent, however, in the treatment of general convulsions of any kind and of whatever origin: eclampsia, epilepsy, etc. As a smaller quantity than is necessary for surgical purposes suffices, the inhalations are not attended with after-effects.

One of the many elements in the toxæmia of puerperal eclampsia is the changing of urea into ammonium carbonate. This salt is demonstrable in the

fæces in eclampsia, and it is the result of the principal change in that complex blood poisoning which by its effects on the nervous system give rise to the convulsions which are so characteristic. It is also well known that chloroform produces a temporary glycosuria; hence we may readily assume that we must have glucose in the blood. If we admit the presence of this sugar in the blood, we can easily demonstrate by our test-tube that it does prevent the changing of urea into ammonium carbonate. Hence chloroform, with its accompanying glycosuria, is the anæsthetic *par excellence* in puerperal convulsions. Not that it will inhibit the development of all the poisons in the toxæmia, but it will limit the production of the chief one. D. H. Stewart (*Medical News*, Jan. 3, 1903).

WHOOPING-COUGH.—In whooping-cough inhalations of chloroform sometimes act in a remarkable manner as a calmative. Violent attacks of cough may usually be stopped by pouring a few drops on the hand and holding the latter a few inches under the child's nose. It is also credited with value in chorea, but the almost continuous abnormal movements in this disease render its use inadvisable.

PARTURITION.—The suffering of labor may also be greatly mitigated without danger by a small quantity of chloroform inhaled from a cone just prior to the oncoming pains. The labor is not retarded and the success of the case is not compromised. The aim should not be to produce unconsciousness, but to blunt the sensibility; given in sufficient dose to produce surgical anæsthesia, the general relaxation of the uterine tissues produced tends to increase the dangers of hæmorrhage. Bedford Brown, however, states that the alterations in the vasomotor system of the pregnant woman enable her to resist the toxic action of chloroform to a greater extent than usual.

RENAL AND BILIARY COLIC.—In renal and biliary colic inhalations of chloroform offer the best source of relief when the suffering is beyond the influence of safe doses of morphine. It is superior to ether in that a much smaller dose is required to relieve the pain, while the after-effects are comparatively *nil*.

A. C. E. Mixture.

A. C. E. mixture is an anæsthetic proposed by Harley (as modified by Martindale), and composed of alcohol, as a menstruum, 1 part; chloroform, 2 parts; and ether, 3 parts; by bulk. It is termed the "A. C. E. mixture" from the initial letters of the names of its ingredients. It is thought to present many advantages over ether or chloroform, being less dangerous than chloroform alone and more speedy in its action than ether.

Administration.—The A. C. E. mixture does not seem to possess the advantages claimed for it in text-books. While entailing the dangers of chloroform anæsthesia, it tends to cause confusion in the recognition of the danger-signals.

The fact, recently recognized, that chloroform is not as safe an anæsthetic for children as was generally thought to be the case, has caused the A. C. E. mixture to be tried as a substitute, but only for the first stage, ether being then substituted.

Even in very small children it is far safer to commence the induction with the A. C. E. mixture and substitute pure ether as soon as that drug can be borne. Commencing with A. C. E. on an open or Skinner inhaler, the A. C. E. is then given in a celluloid mask of Rendle's pattern, gradually adding more and more ether; when a fair quantity of the latter is borne, without hesitation the sponge exchanged for one containing ether alone.

The following advantages claimed: (1) the time required to produce good anæ-

thesia is rarely more than four minutes, (2) the guides to the anæsthetist are clear, (3) flaccidity and freedom from movement during the operation are complete, (4) the after-effects bear comparison with those after any other method, and (5) the method is safe. Even should an inexperienced administrator encounter stoppage of respiration from an overdose,—the only accident to be reckoned with,—all that is needed is a little compression of the chest, the circulation not being prejudicially affected as in the case of such an event under chloroform. The method is recommended especially for children under five or six years, and for any child with obstruction in the upper air-channels. In children above that age the combination of gas and ether is so well borne that nothing need replace it. G. Rowell (Brit. Med. Jour., May 8, '97).

Physiological Action.—Truman has shown that the depressing action of the chloroform upon the heart by the stimulating action of the ether is not based upon chemical facts, the latter vaporizing out of all proportion to the chloroform. In administering the mixed anæsthetics, therefore, a vapor of varying and uncertain composition is employed.

The disproportion indicated by Truman is desirable; the most dangerous period is the beginning, and this corresponds with that of excess of ether. Marshall (London Lancet, Feb. 16, '95).

Untoward Effects.—The deaths occurring after the administration of the A. C. E. mixture seem to be associated with pathological conditions similar to those met with in fatal cases following the use of chloroform.

Death from A. C. E. mixture in an alcoholic subject in whom three previous administrations of the anæsthetic had produced no unpleasant symptoms excepting slight prolongation of the struggling stage. The physical examination showed no lesion of the heart; the urine contained no casts, albumin, or sugar. After a few whiffs and before consciousness was entirely lost, the patient strug-

gled violently and ceased breathing. The pulse continued to beat for nearly a minute after respiration had ceased. No post-mortem permitted. H. S. Jewett (N. Y. Med. Record, Nov. 13, '97).

Oxygen and chloroform combined with a view of avoiding asphyxia. The striking effect of this chloroform-oxygen narcosis is manifested in the following symptoms: After several inspirations the skin and visible mucous membranes become light red. Extremely anæmic and weak patients exhibit a healthy color. The pulse becomes slower and fuller, similar to a digitalis pulse, and its rate is nearly always about 60. Narcosis has reached the surgical stage in little children in one-fourth of a minute; in larger children and women, in three to seven minutes; in men, five to twelve minutes. An insufficiency in the chloroform-supply, with a consequent lightening of the anæsthesia, increases the pulse-rate. Respiration is absolutely uniform, slow, and quiet. A stage of excitement is but rarely observed, and then, as in alcoholics, it is short and moderate in degree. Vomiting during and after anæsthesia is comparatively rare. There is never an increase of secretion of mucus and saliva. The sensations observed when the patient is awakening are agreeable in character.

Personal experience with this form of narcosis comprises more than three hundred cases. One hundred and sixty-six patients were fully conscious immediately after operation; 13 required between 8 and 30 minutes; one woman, after the use of 55 grammes of chloroform, slept 3 hours; 21 dispensary patients got off the table and walked home. Kidney irritation was never observed. Heinz Wohlgemuth (Interstate Med. Jour., Oct., 1901).

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CHLOROSIS.—From Gr., *χλωρός* greenish yellow.

Definition.—An affection of the blood characterized mainly by a reduction of the percentage of hæmoglobin and a greenish hue of the skin.

By a slight stretch of the imagination the skin of a person of dark complexion suffering from chlorosis might be called greenish yellow; but chlorosis is very common in Sweden, where the inhabitants are, as a rule, of a very fair complexion; so that the very name of the disease is, to a certain extent, a misnomer. It has, however, the sanction of ancient usages, and it would be hard to find another to which greater objections could not be raised.

Symptoms.—In investigating the clinical history of a disease which is practically confined to the female sex our first inquiries are naturally directed to the organs of reproduction. We find that chlorosis makes its appearance at or about the time of establishment of menstruation, and the behavior of this function in cases of the disease in question is twofold: It may be either premature or long delayed. Niemeyer states that he has never known the menses to appear between twelve and thirteen years of age in a girl with undeveloped breasts without the supervention of chlorosis. A premature appearance of the menses is, therefore, one of the important events in the clinical history of chlorosis. In such cases, menstruation may appear but once, the discharge being followed by amenorrhœa and chlorosis. In the other class of cases the menses do not appear at the usual time; the breasts and uterus remain undeveloped, while, at the same time, a decided degree of chlorosis makes its appearance. The exact relation between the amenorrhœa and the blood-change is not understood, although it is probable that, in cases of amenorrhœa with a properly-developed genital system, the suppression of menstruation is secondary to the blood-change, whereas in those cases with an undeveloped state of the uterus and its appendages the re-

lation is not so clear. The other symptoms of chlorosis are secondary to the blood-change and include the various manifestations of anæmia in general.

Analysis of 232 cases, showing that imperfect evolution of menstruation, as evidenced by scantiness of the flow and irregularity of the periods, is as regular a feature of chlorosis as the imperfect evolution of the red corpuscles of the blood. These constants were not related to each other as cause and effect, but were independent one of the other. At the same time there is a close relationship between them, whereby the reproduction and development of the red corpuscles of the blood are governed by, or formed part of, the menstrual cycle; and both are influenced by a greater rhythmic action which determined the time and activity of development, growth, and reproduction. W. Stephenson (Brit. Med. Jour., Mar. 16, '89).

It is in this disease that the inorganic cardiac murmurs are so frequently heard, especially over the base of the heart, *i.e.*, over the points of the origin of the aorta and pulmonary artery.

In 205 cases, 115 had cardiac bruits. Of these, 56 were audible at the base, 13 at the apex, 24 at base and apex, and 22 at base, apex, and back. The last group were always accompanied by distinct dilatation of the ventricle and strong impulse; they were the first to disappear under treatment: a fact which shows that they are present in the more advanced cases. In 2 of the 22 cases the murmur persisted after seven and nine months, respectively. These remain as permanent mitral regurgitations. Barr (Amer. Jour. Med. Sciences, Oct., '91).

Many of the bruits supposed to be intracardiac really due to the action of the heart against the lungs. Potain (L'Union Méd., Dec. 23, 30, '90).

The *bruit de diable* and venous hums in chlorosis. The former occurred in 51.4 per cent. of personal cases: a proportion which is low, inasmuch as the hæmoglobinometer, which detects the disease in the absence of pallor and other visible signs, was used. As to venous hums,

none found in 49.4 per cent. of 180 cases; on the right side only in 33.3; on the left side in 6.1, and on both sides in 11.1 per cent. Of 27 cases in which relapses occurred, 66 per cent. have venous hums: a fact which may prove of some use in prognosis. The bruits usually disappeared when the hæmoglobin showed some increase. Richardson (Lancet, June 27, '91).

Venous hums disappear after bleeding cases of chlorosis; hence the cause of these is a plethora, due to hypoplastic blood-vessels. Schubert (Wiener med. Woch., May 2, '91).

Careful examination of the heart in 22 cases of chlorosis gives the following conclusions: In 22 cases of chlorosis, in which no other cause for an alteration of the heart was present, 20 showed an enlargement of the relative heart-dullness, which in a few cases was very marked. This increase should be due only to an increase in the size of the heart. The symptoms during and after the chlorosis allow us to assume that the heart was dilated and hypertrophied. In some cases the enlargement subsided after the symptoms of chlorosis ceased; more frequently the heart remained enlarged for some time after, and slowly attained normal size. The causes of the dilatation and hypertrophy culminate in those of the chlorosis itself. In chlorosis there is a diminution of the functional power of the heart; the normal circulation offers such a heart unusual difficulty, and in consequence it becomes dilated and hypertrophied. In chlorosis there is a convincing example of a transitory hypertrophy. The pathogenesis of the cardiac hypertrophy in chlorosis indicates the importance of congenital or acquired power in the development of any hypertrophy of the heart. Gautier (Deutsches Archiv f. klin. Med., B. 62, H. 1 and 2, '99).

The most striking symptom is the sallow hue of the skin and pale, almost white, color of lips and palpebral conjunctiva. This pallid complexion differs from that of the so-called wasting diseases, such as cancer and phthisis, in not being attended with emaciation. In

fact, the adipose tissue is not only retained, but persons affected with chlorosis are apt to put on flesh, or, rather, fat. This is explained by the fact that, owing to the greatly reduced amount of hæmoglobin, the processes of oxidation in the body are carried on very feebly.

The other principal symptoms of chlorosis are lassitude and indisposition to exertion, loss of appetite, and other digestive disturbances, and constipation.

The dyspepsia of chlorosis due, as Hayem first pointed out, to lack of hydrochloric acid. Liégeois (*Revue Méd. de l'Est*, Sept. 15, '91); Labat (*Gaz. de Hôp.*, Dec. 30, '90); Chéron (*L'Union Méd.*, Dec. 9, '90).

Dyspepsia in chlorosis. Seventy cases of chlorosis examined; an excess of pepsin found in 36, a decrease in 28; an excess of hydrochloric acid in 6, and normal gastric juice in 2. In boys and girls at the age of adolescence there is commonly some dyspepsia from "hyperpepsia," and the advent of chlorosis makes this prominent. Hayem (*La Sem. Méd.*, Nov. 4, '91).

Examinations of the gastric juice of chlorotic patients. Conclusions: 1. The amount of HCl in the gastric juice is not diminished in cases of chlorosis; on the contrary, there is a state of hyperacidity in 95 per cent. of the cases. 2. The dyspeptic disorders of chlorosis are neither due to a deficiency of HCl nor to motor insufficiency of the stomach. 3. The indiscriminate employment of hydrochloric acid in cases of chlorosis is to be condemned. 4. The theories which refer either the origin of chlorosis or its chronic character to a state of gastric subacidity are untenable. K. Osswald (*Münch. med. Woch.*, July 3, 10, '94).

Among the chloroses due to autointoxication is one which clinical and therapeutical observation explains as a thyroid autointoxication. Clinically it is characterized by the usual symptoms of chlorosis, to which are added œdema similar to that of myxœdema, hypertrophy of the thyroid gland, and the signs of a commencing exophthalmic goitre. Therapeutically this chlorosis

disappears under treatment by iodothyryn. The iodothyryn was administered in tablets of 4 grains each, of which from three to five were taken per day, the amount being gradually increased for a considerable period, and then decreased. Jeulain (*Med. News*, Apr. 8, '99).

Nervous symptoms, such as hyperæsthesia, neuralgia, and hysteria are not uncommon. The urine is pale, of low specific gravity, and deficient in urea. While menstruation is, as a rule, either scanty or suppressed, cases are now and then encountered in which the flow is so profuse as to have given rise to the term "chlorotic menorrhagia." Chlorosis is sometimes attended by febrile symptoms.

Fever may occur in the course of chlorosis. It may be subdivided into three classes: cases with (1) continuous, (2) intermittent, and (3) inverted fever. The continuous form is, perhaps, commonest; the intermittent—of which a remarkable case, with wasting, cough, and other suspicious symptoms, occurred in the practice of Jaccoud—is least so. Paul Chéron (*L'Union Méd.*, Dec. 9, '90).

Cases of pure "febrile chlorosis" very rare, the cases usually so regarded being due to fatigue or other complications. Hayem (*L'Union Méd.*, Dec. 9, '90).

But one case met with; most of them are due to constipation and absorption of poisons from the bowels. Potain (*L'Union Méd.*, Dec. 23, 30, '90).

A febrile type of chlorosis does not exist, but a certain degree of apyrexia accompanies true chlorosis. Hence, when fever is present, it must be attributed to some concomitant morbid state, as constipation or tuberculosis. E. Guam (*Il Morgagni*, Dec., '94).

None of the symptoms can be considered pathognomonic. As to the color of the skin, supposed to be due to deficiency of hæmoglobin, the general view is incorrect, as in profound anæmia there is often only the slightest chemical change in the blood, while with no apparent anæmia the change may be profound. There are other coloring matters in the blood of which little is known, and it is to these that the color of the skin is due

in chlorosis. Dyspnœa and headache have also been attributed to deficiency of oxygen, consequent on the deficiency of hæmoglobin; but deficiency of hæmoglobin does not necessarily diminish the amount of oxygen present; it has been shown that there may be even more oxygen than normal in such blood. Great stress should be laid on the clear appearance of chlorotic blood; it is to this clearness, due to some anomaly in the blood-pigments, in which hæmoglobin plays little or no part, that the color of the skin is due. Biernacki (Wien. med. Woch., No. 8, '97).

Complications.—There are certain diseases to which chlorosis stands in the relation of a predisposing cause, and which, therefore, may be considered as complications or sequelæ. The chief of these are phthisis, gastric ulcer, chorea, and exophthalmic goitre. There can be no doubt that one of the best prophylactic measures against phthisis is the maintenance of a good condition of the blood, and that, conversely, a poor state of the blood may be regarded as a pretubercular or prebacillary stage of phthisis.

Gastric ulcer is by no means uncommon in chlorotic women, and its occurrence is favored by degenerative changes in the blood-vessels of the stomach, leading to thrombosis and hæmorrhage and subsequent sloughing in the mucous membrane of that organ. Chorea, it is well known, is decidedly more common in females than in males, and, although more frequently observed under than over fifteen years of age, is yet far from being rare between the ages of fifteen and twenty. Its occurrence is undoubtedly favored by chlorosis. The same is true with regard to that peculiar neurosis known as exophthalmic goitre.

Seven cases of chlorosis complicated with the signs and symptoms of exophthalmic goitre, the latter disappearing as the condition of the blood improved and,

therefore, presumably symptomatic. F. Chvostek (Centralb. f. klin. Med., Apr. 14, '94).

When the aortic valves are affected, chlorosis, though a troublesome complication, does not aggravate the malady. Mitral regurgitation, on the other hand, tends to be exaggerated by a chlorotic condition. In these cases iron not only augments the number of red corpuscles, but will lead to a greater capillary resistance, and, consequently, to an improved circulation. Potain (Jour. de Méd., Aug. 14, '95).

Diagnosis.—The diagnosis of chlorosis is made by an examination of the blood and a careful exclusion of organic disease. As stated under the anatomical characters of the disease, the blood-changes are not uniform. There is, however, usually a decided, sometimes a very great, decrease in the percentage of hæmoglobin. In the majority of cases, also, if the disease has lasted several weeks, the blood-corpuscles are diminished in number. For example, in the well-marked case of a young girl, aged 17, whose blood I recently examined, I found the following condition:—

No. r. c. per cubic mm., 2,690,000
Hæmoglobin 32 per cent.

The percentage of red corpuscles as compared with the healthy standard (5,000,000) was, therefore, 54, so that the value of each corpuscle (the "hæmic unit") was only $\frac{32}{54}$ of the normal, making the real value of the 2,690,000 corpuscles only equal to 1,594,080. Hayem gives 3,520,000 corpuscles per cubic millimetre as the mean of 18 counts, and Coupland about 3,000,000 as the mean of 7 counts. There are conflicting statements with reference to the size and shape of the red corpuscles, and there can be no doubt, as already stated, that they may be normal or subnormal in size.



Appearance of the Fundus in two cases of Chlorosis. (C.A.Oliver)

Bright's disease, which is often very insidious in young people and attendant with great anæmia, is excluded by a careful examination of the urine.

Chlorosis is, as a rule, with few exceptions, a non-febrile disease, and, therefore, if the temperature be elevated, latent tuberculosis should be suspected. A cardiac murmur should not be hastily set down as inorganic, for long-continued anæmia is one of the recognized causes of chronic endocarditis.

Cardiac murmurs appearing in the course of chlorosis are indicative of gastro-intestinal disorders that influence the volume of the heart. Nicolas (*Gaz. Hebdom. de Méd. et de Chir.*, Jan. 11, 1900).

The blood diseases from which chlorosis should be differentiated are the following:—

PERNICIOUS ANÆMIA.—In this affection the skin is more yellow than greenish. Blood-examination shows a relative increase of hæmoglobin and the presence of gigantoblasts; there is also marked oligocythæmia.

LEUCOCYTHÆMIA.—The microscope shows the characteristic increase of white corpuscles, their ratio to the red corpuscles becoming sometimes 1 to 30 instead of 1 to 600, the usual proportion.

LEUKÆMIA.—The facial discoloration is much less marked and the lips are red, instead of pale as in chlorosis.

HODGKIN'S DISEASE.—In this affection the glandular enlargement is more or less marked, and serves to easily differentiate it from chlorosis, in which the lymphatic glands do not play a special rôle in the general dyscrasia.

Warning against hasty diagnosis of chlorosis from mere inspection. There are various deceptive features, including certain anæsthesias and analgesias, comparable to those of hysteria, but not to be confounded with such. Asthma is a common symptom. The disease has

been growing more infrequent, owing to the better hygienic conditions of our time. Potain (*L'Union Méd.*, Dec. 23, 30, '90).

Examination of the fundus frequently elicits a lustreless, dull, and grayish appearance of the optic nerve, when the hæmoglobin is greatly reduced. Inflammation of the optic nerve is occasionally observed.

Emphasis on the statement that there is in chlorosis a greater tendency to inflammation of the optic nerve and retina than in pernicious anæmia, while the tendency to retinal hæmorrhage is considerably less. The latter fact is notorious, but the former is not so generally recognized. Stephen Mackenzie (*Clinical Jour.*, Jan. 10, '94).

A case in a girl, aged 21, in which optic neuritis occurred in the course of chlorosis. Dieballa (*Deut. med. Woch.*, July 9, '96).

While examination of the fundus often gives indications of anæmia, it does not always do so, especially in cases of anæmia of moderate degree. In chlorosis ocular manifestations are more frequent than was commonly supposed, for, in nearly every case in which the hæmoglobin is markedly reduced, changes in the fundus may be found. The most common change is a dull, lustreless, grayish appearance of the nerve. In pernicious anæmia clinicians have observed retinal hæmorrhages, but they are not so uniformly present as some have supposed. As a rule, they occur in the advanced stage. In initial anæmia from loss of quantity of blood there are seldom ocular changes unless some other factor than loss of blood exists. W. C. Posey (*N. Y. Med. Rec.*, July 10, '97).

Marked case of chlorosis in which the fundus was examined: The surface of the disc was of mottled yellowish white. Its edges were hazy and at places were almost indiscernible. The fibre-layer of the retina, which itself was visible to a more or less degree throughout the fundus, was thickened, opaque, and intensely striated. The underlying choroid, so unlike that which is so common in

the negro race, was but sparingly and irregularly pigmented. The retinal veins and arteries, particularly the former, were pallid, with a thickening and pronounced opacification in many places of their lymph-sheath walls. To the nasal side of the disc two faintly-marked lymph-massings could be dimly seen. (*See colored plate, Fig. I.*)

The fields of vision for white and red, especially the former, as shown in sketch 2, were markedly contracted.

Careful testing and retesting of the urine failed to show any course disturbance or evidence of general dyscrasia.

Examination of the blood: The red cells amounted to but 1,608,000, and the white ones were decreased to 3490. The hæmoglobin equaled but 22 per cent. The red cells were quite irregular in size, both microcytes and macrocytes being present. A few nucleated red cells could be seen, but there were some of all types. None of them could be determined to be in the process of cell-division.

Examination of the eyes of a case of chlorosis, while the blood showed that the red corpuscles were as low as 300,000, the whites 2500, and the hæmoglobin reduced to 24 per cent., nucleated red corpuscles being present. The pupils were of the same size. The irides responded equally to light-stimulus. There was a marked tremor of the orbicularis muscle of the right eye. The fields of vision, as well as could be taken, were reduced concentrically. The eye-grounds were about the same on each side. There was a disposition to hæmorrhages into the retina that were characteristic of both the Quincke and the Horner types. The disc was pallid. The retina was somewhat œdematous in the naso-macular region. The larger hæmorrhages, which, as a rule, were deeply seated beneath the fibre-layer of the retina, presented both white and grayish centres, and, as shown in the figure, one enveloped a portion of the lower temporal vein. More careful study made it apparent that a few of the white areas in the hæmorrhages were due to leucocytic aggregation, though the bulk of them were dependent upon tissue-degeneration. (*See colored plate, Fig. II.*)

Charles A. Oliver (Trans. Amer. Ophth. Soc., '97).

Etiology.—The chief predisposing causes of chlorosis are to be found in sex, age, and constitution. The forces emanating from these sources come to a focus, so to speak, in a case of chlorosis and that which brings them to a focus in the advent of puberty. The principal of these predisposing causes is, I believe, a congenital tendency to anæmia. Some years ago, while examining the blood of the new-born at the Maternity Hospital, I discovered an infant whose red blood-corpuscles numbered only 3,625,000 per cubic millimetre, the normal average being at least 5,000,000. Now, this child which, by the way, was a female, might, under proper treatment, thrive until the age of puberty, when the demands made upon the blood by the evolution of the sexual system would, in all probability, give rise to well-marked chlorosis. The chief predisposing causes of chlorosis are, I repeat (1) sex, the vast majority of cases occurring in females; (2) age, the decade between fourteen and twenty-four furnishing most of the cases; (3) constitution, either inherited or acquired.

True chlorosis, when not traceable to external injury or to a primary disease, is a disorder of development, like any other such disorder or sign of physical degeneracy. It is very frequently associated with infantile types of structure in the adult patient, especially ill-developed pelvis, labia, uterus, pudendal hair, and breasts. Stieda (Zeit. f. Geburtsh. u. Gynäk., B. 32, H. 1, '95).

Chlorosis is the result, not the cause, of amenorrhœe: a menstrual autointoxication. Immediately before the period the toxicity of the serum is at a maximum. Wet-nurses who menstruate during lactation are apt, during the days preceding the show of blood, to cause their sucklings to suffer from diarrhœa and cutaneous eruptions. Such women

themselves often have herpes and fever. Menstruation is a true excretory process: a purging of waste-products. Charrin (*Méd. Mod.*, Jan. 11, '96).

Chlorosis looked upon as the symptom of a general neurosis, in which many other symptoms arise through the anæmic blood. Altered composition of the blood ascribed to a morbid function of the vasomotor nerves, which gives rise to polyplasmia, lymph-congestion, and imperfect development of red blood-corpuscles. That chlorosis is essentially a disease of puberty may be explained by the fact that, at the time of development of the female sexual organs, the vasomotor nerves are especially disposed to disease, just as, in still earlier periods, the motor functions are prone to affection, as in chorea. E. Grawitz (*Fortschritte der Med.*, Berlin, No. 3, '98).

The family history of 36 cases of chlorosis studied during the last five years to ascertain the connection between chlorosis and tuberculosis. In 1890 Jolly concluded from an examination of 54 cases that in the majority of instances a personal or family history of scrofula or tuberculosis was to be found. The 36 cases now recorded, however, show that tuberculosis has not any more influence in the causation of chlorosis than have other pathological states. The influence of hereditary tuberculosis is only exerted by enfeebling the stock. Leclerc and Levet (*Lyon Méd.*, Aug. 4, 1901).

EXCITING CAUSES.—The exciting causes of chlorosis are those of anæmia in general, such as insufficient food, light, air, and exercise; overwork, either physical or mental; anxiety, grief, and nervous excitement in general. There is another exciting cause on which great stress was laid by the late Sir Andrew Clark and which, therefore, deserves to be considered at some length. The cause to which I refer is constipation, and Clark regarded it of such paramount importance that he used the term *fæcal anæmia* as a synonym of chlorosis. This theory of Clark is based upon certain signs and

symptoms that are commonly encountered in chlorosis. Chief among them are digestive disturbances. The tongue is generally heavily coated at the base, large, flabby, and with its sides indented with the teeth. The breath is disagreeable and sometimes, according to Clark, has a distinctly fæcal odor. The bowels are either confined or inadequately relieved, and the fæces consist of scybalous masses imbedded in mucus swarming with bacteria. Pain in the side, most marked on the left, is a common symptom, and is believed by Clark to have its seat either in the hepatic or splenic flexure of the colon. This view of the nature of the pain in the side is corroborated by the fact that it may be relieved by large enemata of warm water. According to the authority just named, it is a common thing for young girls to neglect the calls of nature, so far as the bowels are concerned. The fæces accumulate, and, by their decomposition, ptomaines and leucomaines are generated, absorbed, and, by their poisonous action, produce the multiform symptoms of chlorosis. A treatment based upon the theory that chlorosis is due to fæcal retention is sometimes eminently successful, and will be referred to later in detail.

Three cases of chlorosis characterized by the presence in the urine of a peculiar "chromogen"—a colorless substance which becomes converted into a pigment of oxidation. It is manifested by the urine becoming a rose-red color on the addition of nitrous-nitric acid; *i.e.*, pure nitric acid to which a small quantity of the common yellow acid of commerce has been added. Chromogen is a derivative of skatol, and, therefore, derived from fæcal absorption. In all cases there was marked constipation, the relief of which by large enemata constituted the basis of his treatment. Restoration to health coincided with disappearance of the urinary chromogen.

George Herschell (Practitioner, May, '93).

Chlorosis is of intestinal origin. Diminution of urobilin in the urine an important sign. A toxic body found in the urine, "the exact nature of which it has been as yet impossible to determine," but which is believed to be largely accountable for the nervous phenomena of chlorosis. F. Forchheimer (Therap. Gaz., Nov. 15, '93).

Another exciting cause of chlorosis is cold. Prof. Augusto Murri, of Bologna, has published an elaborate paper on the influence of cold in the etiology of chlorosis. He gives the notes of three cases, in which the symptoms of the disease were limited to the cold months of the year, disappearing in summer and recurring at the onset of the succeeding winter, and he states that others precisely similar have come under his observation. He, therefore, styles them "winter chlorosis," or *chlorosis hiemalis*. It is well known that chlorotic patients are often affected unfavorably by such exposure to cold as is well borne by the healthy, and this Murri believes to be due to an instability of the vasomotor system on the part of the former. In fact, he regards chlorosis as a vasomotor neurosis, the blood-changes in the disease being induced by cold, nervous shock, or long-continued irritation from the genital organs or elsewhere.

Meinert, of Dresden, claims to have demonstrated a displacement of the stomach (gastroptosis) in sixty consecutive cases of chlorosis. Fifteen per cent. of the cases were complicated with right movable kidney and in one case both kidneys were movable. The gastroptosis is secondary to enteroptosis and this, in turn, to the pressure of the corset; so that, according to Meinert, it is to this article of female apparel that chlorosis is due. After the cure of a case of chlorosis, its anatomical sub-

stratum, the visceral displacement, remains, and hence the notorious tendency of the affection to relapse.

No one doubts the evil effect of tight-lacing, and all will admit that in a person predisposed by inheritance or otherwise to chlorosis the development of the disease may be accelerated by constriction of the thoracic base and consequent displacement of viscera.

Chlorotic subjects often present a high position of the diaphragm. The liver-dullness begins at the upper edge of the fourth or the lower edge of the third rib. The heart-dullness is sometimes found to extend either to the right or to the left. This enlargement of the area of the heart-dullness is probably due in but a few cases to dilatation. Frequently it is of a certainty due to the elevated position of the diaphragm, in consequence of the diminished volume of the lungs. F. Müller (Berl. klin. Woch., Sept. 23, '95).

In a series of 29 cases dilatation of stomach without retention found in 8 cases; dilatation of stomach with retention found in 6 cases; flatulent dyspepsia in 14 cases. Chlorotic patients are more concerned with the pale color, breathlessness, swelling of the feet, and palpitation than with gastric disturbances. In 17 cases, however, dyspepsia preceded the chlorosis; in 2 cases both appeared simultaneously, and in the remainder the relation could not be determined. Mongour (Archives Clin. de Bordeaux, Nov., '96).

As to Meinert's contention that chlorosis is produced by the gastroptosis brought about by the pressure of the corset: It may be possible to define the outline of the stomach in cases of considerable gastroptosis where the upper curvature lies below the liver and the abdominal walls are lax; but in young subjects, such as chlorotic girls, the chlorotic walls are not lax. In a large number of chlorotics, who wore corsets, to map out the lesser curvature of the stomach was found impossible. It is usual, however, in such cases to find the greater curvature extending lower down than usual; this is possibly due to an

abnormal distensibility of the stomach: a condition occurring as a result of chlorosis. Leo (*Deut. med. Woch.*, Mar. 19, '96).

There are those who regard chlorosis as an infectious disease. Chief among them is Clément, of the Hôtel-Dieu, Paris, who bases his opinion of its infectious nature on the enlargement of the spleen, which he has found in thirteen cases; on the frequency of fever, the occasional complication of phlegmasia dolens, and the epidemic occurrence of the affection. The hypothesis is well argued, but the facts upon which it is based are questionable.

Blood of chlorotic patients examined for micro-organisms, and in ten or twelve cases either the streptococcus albus or the staphylococcus albus found, the former being the more abundant, and—in rarer instances—the bacillus coli. Lemoine (*Le Progrès Méd.*, Nov. 17, '94).

Thrombi may form in the cerebral sinuses and cervical veins, though usually they occur in the femoral vein. They necessarily cause death; the two recorded instances of thrombi in the jugular vein ended in recovery. Infection the cause. Bourdillon (*Jour. de Méd. et de Chir. Prat.*, Sept. 10, '92).

Enlargement of the spleen observed in twenty-one out of fifty-six cases of chlorosis. Inasmuch as a "fœtal state" of the spleen, marrow, and other hæmatopoietic organs has been described as characteristic of chlorosis, this observation is interesting. F. Chvostek (*Allgemeine med. Central-Zeitung*, July 22, '92).

Study of thirty-one cases: Chlorosis is, in the great majority of cases, the result of malnutrition, dependent upon the consumption of an insufficient amount or of an unsuitable quality of proteid; in most cases a great diminution of the nitrogenous excreta of the urine found, while a common symptom of chlorosis is a perversion of the appetite to the excessive consumption of starches and sugars. The superiority of such preparations as ferratin over the inorganic forms of iron suggests that there is value in the proteid material which they contain.

Simon (*Amer. Jour. of Med. Sciences*, Apr., '97).

Chlorosis is due to a transient incapacity of the blood-forming organs occurring during puberty, or to an hypoplasia of those organs, manifesting itself more or less throughout life, and occasionally resulting in the hypoplasia of the vessels described by Virchow. This weakness of the blood-forming apparatus manifests itself in the production of less valuable erythrocytes, deficient in hæmoglobin and altered in form. Hofmann (*Münchener med. Woch.*, July 18, '99).

Prognosis.—The prognosis of uncomplicated chlorosis is invariably good, the response to appropriate treatment being prompt and decided. It should be borne in mind, however, that intercurrent disease of any kind is apt to be unusually severe. This is especially true with reference to febrile disorders, which occasion great and rapid consumption of the blood-corpuscles in healthy persons. As a matter of course, the powers of resistance to such affections are much reduced in those whose blood is already impoverished. In forming a prognosis the tendency of the disease to relapse should not be forgotten. This is especially marked in those cases in which the development of the vascular and reproductive systems is imperfect; in other words, in those in whom the tendency to anæmia is congenital. Predictions of permanent cure after a single course of treatment should, therefore, be made with great reserve or, better still, should not be made at all.

Pathology.—Virchow endeavored to place chlorosis upon a distinct anatomical basis by the demonstration that, in fatal cases, there is often found an imperfect development of the aorta and arterial system generally. He has found the aorta of a full-grown woman so small as barely to admit the little finger, whereas, normally, it should admit the

thumb, and, with this condition of the lumen of the vessel, its coats were found to be much thinner than normal. He regards this condition of the vessels as congenital, and the importance of the observation depends upon the fact that the blood-vessels and the blood-corpuscles are both derived from the same embryonic layer,—the mesoblast,—an imperfect development of the one necessarily entailing the same condition of the other. There is little doubt that Virchow's observation is true with reference to some of the cases, especially those that run a fatal course. A condition of imperfect development of the vascular system might, doubtless, give rise to grave disturbances of nutrition eventually ending in death; but chlorosis is not a fatal disease, the great majority of cases under appropriate treatment terminating in recovery, and with reference to them there is no proof that such a stunted condition of the blood-vessels is present.

The only constant anatomical changes of chlorosis are those of the blood itself, and it is for this reason that the disease is classed among the primary anæmias. Even the blood-changes are not uniform. The researches of Duncan in 1867 first established the fact that, in well-marked cases of chlorosis, the number of red corpuscles might be normal, while their percentage of hæmoglobin might be greatly reduced, and this anomaly was, for a long time, regarded as the distinguishing mark of chlorosis. It has since been established that this view of the blood-change in chlorosis is altogether too narrow, and at the present day it is generally admitted that the blood-changes in chlorosis may be at least threefold: 1. They may be of normal size and number, their only change being a deficiency of hæmoglobin. 2.

They may be diminished in number, with diminished percentage of hæmoglobin. 3. They may be diminished in size and normal in number and in percentage of hæmoglobin. Of these varieties, the second is the most severe, and in it there are often marked changes (poikilocytosis) in the shape of the red corpuscles, such as are so commonly observed in pernicious anæmia.

From these facts it is evident that there is nothing uniform in the behavior of the red corpuscles in the disease called chlorosis; so that an attempt to describe it as a distinct disease from an anatomical stand-point must result in failure. The essential point is that the percentage of hæmoglobin is reduced, but this is common to many forms of anæmia.

Chlorosis is due to oligochromæmia, the result of faulty hæmopoiesis, in turn due to diminished hæmoglobin production. Hæmoglobin is principally formed in the intestine; this is proved (*a*) by direct investigation upon lower animals, and (*b*) by direct observation upon the human being. Hæmoglobin formation can be increased by the introduction into the intestine of agents not containing iron, but preventing putrefaction. Chlorosis is due to a prevention of hæmoglobin formation by destructive agents acting upon the precursor of hæmoglobin in the intestine. Forchheimer (Boston Med. and Surg. Jour., Aug. 24, '93).

The albumin is diminished, owing to the diminution of hæmoglobin; the relation of albumin to globulin is normal and the amount of fibrin increased. There is considerably more fat than normal in both the serum and the erythrocytes; the lecithin is diminished in the total blood and the serum, but seems to be increased in the red cells. Cholesterol is present in smaller amounts in both the serum and red cells. In the ash, phosphoric acid, potassium, and iron are considerably reduced, calcium and magnesium are increased. The increase of sodium chloride is only apparent, since

chlorotic blood contains a higher percentage of serum than normal blood; the amount of sodium chloride in the serum is not, however, increased. F. Erben (*Zeitsch. f. klin. Med.*, vol. xlvii, Nos. 3 and 4, 1903).

It has been contended by some writers, especially by Immermann, that chlorosis differs from all other forms of anæmia in that the albuminous bodies of the blood-serum are present in that fluid in normal or increased amount. This has certainly been proved to be true in a few cases by chemical examination, but it has not yet been proved that the same may not be true of other forms.

From the above it appears evident that the conditions of the blood and the other organs of the body are so various as to veto the present establishment of chlorosis as a disease with a distinct anatomical basis. With advancing knowledge, some etiological or pathological fact common to all cases of the affection may be discovered, but at present none such is known. With our present knowledge, the most sensible view of the nature of chlorosis appears to me the following, which I have already expressed elsewhere: At the time of puberty there is an urgent physiological demand upon the blood, which is complied with by vigorous persons without detriment to the organism. The ordeal of puberty is safely passed. In less vigorous, but still sound, healthy organisms a decided degree of anæmia, one calling for treatment, declares itself at this time. Finally, in those with any congenital tendency to anæmia, whether this be due to general malnutrition during intra-uterine life or to a special hypoplasia of the vascular system, the anæmia of puberty is intense; the case is a typical one of chlorosis.

Cases of chlorosis may be divided into three classes: (1) Chlorosis with vas-

cular hypoplasia without change in the sexual apparatus; (2) chlorosis with vascular hypoplasia and excessive development of the genital apparatus; (3) chlorosis with vascular hypoplasia and defective development in the genital apparatus. Even though later researches may show that the vascular hypoplasia is not constant, the lesions of the vessels and the heart will occupy, nevertheless, a prominent place in the pathological anatomy of chlorosis. Gilbert, of Paris (*Med. Record*, Oct. 2, '97).

Treatment.—As Immermann remarks, "there is scarcely any point in therapeutics so fully established as the remarkable efficiency of iron in removing all the symptoms of chlorosis"; but it does not follow that iron should initiate the treatment in every case. Nearly all chlorotics are dyspeptic, and until the digestive disorder is relieved the full benefit of iron cannot be obtained. In cases of atonic dyspepsia, the simple bitters, such as quassia or gentian or excitors of the smooth muscular fibres, such as strychnine or brucia, may be administered before meals or, if there is gastric dilatation, naphthol, bismuth salicylate, or chloroform-water may be administered three or four hours after meals, as recommended by le Gendre, in order to arrest the abnormal fermentations usually present in that condition. Lavage is rarely, if ever, necessary. Hyperacidity of the gastric juice should be treated with full doses of alkalies—soda, chalk, lime-water, or magnesia—from one to two hours after meals and anacidity with full doses of dilute hydrochloric acid immediately after eating.

The dyspeptic disorders so often met with may become a serious obstacle to active treatment; such cases should be looked upon and treated as simple dyspepsias, until the stomach be brought into condition for the treatment of the chlorosis itself. Hayem (*La Sem. Méd.*, Nov. 4, '91).

The first object is to improve the gen-

eral condition, then exercise in the open air. A. Hoessli (Deut. med. Woch., Sept. 15, '92).

Such mild laxatives as compound licorice-powder and cream of tartar. The preparation of iron used will depend upon individual conditions. Bland's pill and the tincture of the chloride of iron are preferred. Arsenic ought not to be used alone, but forms a good adjuvant, especially in the form of arsenical waters, like the Roncegno or Levico. Sulphur, so highly lauded by Schultz, acts probably by stimulating the bowels. Nothnagel (Wiener med. Presse, No. 52, '92).

Sulphur bears very intimate relations to cellular protoplasm, and acts in a more important manner in chlorosis than as a mere laxative. It is indicated when iron does not seem to act and when there is not gastro-intestinal irritation. After it has been used for a time, iron may again be administered instead, and with better hope of success than before the sulphur was used. Schultz (Berliner klin. Woch., Mar. 28, '92).

Dietetic treatment of chlorosis. This should vary somewhat, according to whether the patient is lean or fat. Lean patients should be given food "copious in quantity and favoring the deposit of adipose tissue." This includes large quantities of butter and such "amylaceous foods as do not irritate the stomach," and about 3 ounces of meat per diem. Unnecessary muscular exertion and exposure to cold should be forbidden, and in some cases absolute rest may have to be enjoined. The fat chlorotics may be allowed as much as 4 ounces of albumin per diem, and, in addition, no more fat and carbohydrates than will cause the nutritive value of the food to exceed 18 calories per pound of body-weight. Carl von Noorden (Inter. Med. Mag., May, '94).

Milk should be used, or, if this is badly borne, pure water or a hot, weak infusion of tea (hot drinks excite the gastric secretion), eggs, *purée* of vegetables, lean fish, fowl, and cooked fruits. One-half hour before the meal a small dose of an alkali, as sodium bicarbonate, $7\frac{3}{4}$ grains, should be prescribed for the purpose of exciting the flow of gastric juice. At

the same interval after it a Madeira glass of hydrochloric acid in solution in water, 1 to 250. The hydrochloric may be replaced by lactic acid, 1 or 2 grammes (15 or 30 grains) after meals. It is necessary to forbid the use of wines, cinchona-wine, strong beers, alcoholic drinks and stimulating food. If there are gaseous formations, lavage, either of pure water or water containing salicylic acid, 1 per 1000, is indicated. After two to four weeks of this treatment the use of the preparations of iron can be begun. Henri Huchard (Revue Gén. de Clin. et de Thér. Jour. des Prat., Jan. 19, '95).

Rest in bed, when sufficiently prolonged, is of the greatest importance, checking the too rapid destruction of the red globules. The choice of food is made subordinate on account of the dyspepsia which generally accompanies chlorosis. There is often an hyperpepsia of medium degree and some dilatation. In such cases the food at first should consist of milk and raw meat; later on, of under-done eggs, the easily digested varieties of fish, *purée* of green vegetables, and stewed fish. No bread is allowed for four or five weeks. In about 20 per cent. of the cases the gastropathic state is more pronounced and needs more care. Sometimes there is intense parenchymatous gastritis, with marked dilatation; again, there may be a gastritis which has caused diminished glandular secretion and an hypopeptic state. In the former case, in addition to restricted diet, massage is to be used, and lavage also, when abnormal fermentation exists. By the use of these measures it is generally possible to begin ferruginous treatment in from two to four weeks. In hypopeptic conditions, however, iron (either Bland's pills or the protoxalate) may be used from the first before meals and hydrochloric acid a half-hour after eating. Hayem (Le Bull. Méd., Apr. 21, '95).

According to Dr. Haig, of London, who has done so much to increase our knowledge of lithæmic conditions, "iron cures anæmia by clearing the blood of uric acid." When iron fails to cure chlorosis, he recommends its suspension

and the administration of mercurials and salicylates until the blood is cleared of uric acid, after which improvement may occur, without the resumption of iron.

There has been much discussion concerning the *modus operandi* of iron in chlorosis. A study of a few cases, perhaps even of one, will lead the reflecting physician to the conclusion that the cause of chlorosis is not a deficient supply of iron, but something that interferes with its assimilation. Nearly all our food-substances contain iron, and there is probably no drinking-water in which traces of it cannot be found. It is evident, therefore, that there is something that interferes with the assimilation of the iron which is abundantly present in the food of chlorotic persons.

Until quite recently, no satisfactory explanation could be given of the efficacy of iron in chlorosis and especially of the necessity of administering it in large doses, for it was known that very little of the drug was absorbed. Nearly all the iron given by the mouth can be recovered in the *feces*, and, therefore, it would appear that a large portion of the drug is wasted and that equally good results might be obtained by its use in small doses. This, however, is not the case, and, thanks to the investigations of Bunge, we have, at the present time, at least a working-hypothesis on which to base our employment of the metal. In the first place, our food, which contains all the iron we need, does not contain it in inorganic form, but in an exceedingly complex organic combination. Now, in chlorosis, as is so emphatically insisted upon by Sir Andrew Clark, digestive disturbances are exceedingly common. Abnormal fermentations and decompositions take place in the gastro-intestinal tract which give rise to the formation of quantities of sulphides. These decom-

pose the iron contained in the food and completely unfit it for the purposes of nutrition. By administering an inorganic preparation of iron we protect the organic combinations of that metal in the food, for the sulphur in the intestine combines with the iron administered, and allows that normally contained in the food to be absorbed. This theory of Bunge also explains why it is sometimes necessary to administer colossal doses of iron, for, in such cases, the decompositions in the intestine are usually active, sulphur is formed in large quantity and requires a proportionally large amount of iron to take it up.

It is only proper to add that Bunge's theory has lately been contested by Ralph Stockman, of Edinburgh, who claims to have cured cases of chlorosis with sulphite of iron, and who contends that bismuth, manganese, and other drugs which are just as capable of absorbing sulphuretted hydrogen as is iron, are inert in chlorosis. Stockman, nevertheless, acknowledges that the promptest curative effects are obtained with inorganic preparations of iron.

There has been a great deal of discussion concerning the relative merits of organic and inorganic preparations of iron, and there can be little doubt that both are effective. The protoxalate is a favorite preparation of certain eminent French practitioners, while others claim that the best results are obtained with the sulphate, either alone or combined with potassium carbonate, as in the well-known pill of Blaud. For my own part, I am accustomed to place the most reliance on the inorganic salts of iron, although I have obtained good results with both the malate and the lactate. So far as iron is concerned, the efforts of pharmacists seem, of late, to be directed toward the production of

preparations which resemble the organic iron compounds of the food. This seems a misdirection of endeavor, for it is just this iron of the food which is not assimilated by chlorotics.

All preparations of iron do not act identically. They may be divided into five groups: (1) the ferrocyanides, which have no action; (2) the blood from an organism of the same species, which may be useful during a certain period; (3) hæmoglobin in solution, which probably penetrates rapidly into the circulation and is assimilated; (4) the ferruginous salts of vegetable acids, which, at least by subcutaneous injection, are taken up by the circulation, and deposited in the liver; (5) insoluble preparations and ferric-oxide salts, which dissolve in the stomach and later form albuminates and absorbable iron. Bland's pills and acid lactate of iron have seemed to be the most active in chlorosis. A daily dose of 1 to 1 $\frac{3}{4}$ grains is sufficient. For hypodermic injection a 5-per-cent. solution of ferric citrate may be used, a quantity containing from 1 to 1 $\frac{3}{4}$ grains being injected daily. Quinke (*La Presse Méd.*, Apr. 10, '95).

Results of treatment by inhalation of oxygen-gas at half the atmospheric pressure in three cases of chlorosis in women, all of whom had previously been treated with iron, and one of them with arsenic as well. In one case there were signs of phthisis. Oxygen inhalations were given three times daily with marked improvement. Iron is not indicated in cases where there is nervous excitement or where digestion is impaired. Such cases do better under arsenic combined with oxygen inhalations diluted with nitrogen. Corish (*N. Y. Med. Jour.*, Feb. 13, '97).

Under the influence of iron administered hypodermically menstruation is re-established, and this effect is dependent upon the general improvement of the organism and the excitant action or hyperæmia induced by the drug. Under the injection of manganese the reappearance of the menses is more tardy, although the general health is much im-

proved. The reappearance of menstruation is always followed by an improvement in the general health and in the blood. Iron and manganese act especially as reconstituents, not exclusively upon the hæmoglobin, but also upon the red cells. Arsenic does not materially increase the hæmoglobin, but it notably increases the number of red cells. Steffanelli (*Settimana Med.*, Nos. 40 and 41, '99).

Hæmalbumin recommended for the relief of chlorosis. It is a powder readily soluble in hot water or alcohol, and contains all the salts and albumins present in the blood. Dose of hæmalbumin is 15 grains three times a day. Golinier (*Deutsche med.-Zeit.*; *Med. News*, Apr. 15, '99).

Sanguinal recommended very highly in the treatment of anæmia and chlorosis. Sanguinal contains 10 parts of chemically-pure hæmoglobin, 46 parts of the normal blood-salts of the human blood, and 44 parts of muscle-albumin. Each pill represents about 75 grains of fresh blood. Victor Reichsberg (*Deutsche med.-Zeit.*, May 21, 1900).

In conclusion, I will describe the method of treatment so strongly advocated by Sir Andrew Clark. With careful attention to the diet and a tepid sponge bath, followed by brisk toweling night and morning, he prescribes the following mixture:—

R Ferri sulphatis, gr. xxiv.
Magnes. sulphatis, 5vj.
Acid. sulph. aromat., 3j.
Tinct. zingib., 3ij.
Infus. gentian comp. vel quassiaë,
5viii.

M. Sig.: One-sixth part twice daily, about 11 and 6 o'clock.

Occasionally this acid mixture produces sickness, dries the skin, and is otherwise ill borne. In such cases he prescribes the following alkaline mixture:—

℞ Ferri sulphatis, gr. xxiv.
 Sodii bicarb., ʒij.
 Sodii sulphatis, ʒvj.
 Tinct. zingib., ʒij.
 Spt. chloroformi, ʒj.
 Infus. quassiae, ʒviij.

M. Sig.: One-sixth part twice daily, at 11 and 6 o'clock. Sometimes neither mixture agrees with the patient, in which he prescribes sulphate of iron in pill with meals and a saline aperient on first waking in the morning. By this plan Clark claims that nine out of ten cases recover in from one to three months, and by careful attention to the bowels, taking twice a week a pill composed of aloes, myrrh, and iron, the recovery will probably be permanent.

Summary showing the average gain in hæmoglobin per week from the use of various agents: Betanaphthol, 2 grains three times daily (antisepsis), 30 cases, 1.85 per cent.; Blaud's iron pills, 5 grains three times a day, 31 cases, 5.07 per cent.; cathartics alone, 7 cases, lost 1.50 per cent. Twelve cases treated with Blaud's pills after a course of betanaphthol showed an average weekly increase of 6.70 per cent.; 19 cases treated with Blaud's pills without betanaphthol showed an increase of but 4.50 per cent. Series of 28 cases treated during an average period of 4.3 weeks, with 2 grains of betanaphthol, in tablet form, and 5 grains of Blaud's iron pills three times a day. The average gain in hæmoglobin per week was 7.9 per cent., the maximum gain being 20 per cent. per week for 2 weeks in one case, 14 per cent. for 3 weeks in another, 13 per cent. for 4 weeks in another, while another patient averaged a gain of 11.4 per cent. per week for 5 weeks. The average amount of hæmoglobin possessed by the patients before beginning the treatment was 48 per cent. After 4.3 weeks of treatment it was 82 per cent. Conclusion that the results of combined treatment are considerably better than those obtained with iron alone, and much better than those obtained with betanaphthol alone. Town-

send (Boston Med. and Surg. Jour., May 27, '96).

Chlorotic cases can be divided into three classes: Those in which iron is absolutely useless, those in which it is fairly valuable, and those in which it is an absolute necessity. The cases in which it is useless are those which have been deprived of fresh air and sunshine, and only need proper food and out-door life, with stimulant treatment, to regain their health. Those in which it is moderately valuable are the pseudochlorotics who have as an underlying cause a tendency to develop tuberculosis with general debility; but, as a rule, the more dyspeptic the patient, the less good will iron do. The cases in which the iron is most useful are those in which the patients are devoid of dyspeptic symptoms, when any one of the common iron preparations may be given in large or small doses with advantage. Should there be a syphilitic dyscrasia underlying the anæmia, mercurials should be administered in addition to the iron, preferably the bichloride of mercury. Huchard (Revue de Thér. Medico-Chir.; Ther. Gaz., Sept. 15, '97).

In cases in which there is an acceleration of the heart-beats recourse has been had to medicaments, diminishing the apparent action of the heart, such as digitalis. These therapeutic agents have very little success in such cases, their action being only temporary; so that the palpitations recur; while for some patients digitalis is even hurtful. Dependence should, hence, not be placed upon these agents, but rather upon those acting upon the nervous system, as bromide of sodium, valerian, camphor, etc. (Potain.)

The salts of copper are especially valuable in chlorotics with cervical lymphadenitis. Cases without tuberculosis do best under iron or arsenic. But scrofulo-tuberculous cases are most benefited by phosphate of copper. Mendini (Jour. des Praticiens, Apr. 27, 1901).

The practice of Mendini in employing copper salts in chlorosis, amenorrhœa,

and cervical lymphadenitis recommended. The acetophosphate is preferred, and in many of the cases under observation for the past twenty-five years marked improvement in the blood condition has resulted. E. Liégeois (*Jour. des Praticiens*, vol. xv, p. 225, 1901).

Bone-marrow and ovarian extract have been employed with some success in the treatment of chlorosis, but their value has not, as yet, been sufficiently established to warrant more than an encouragement for further trial.

Ovarian substance tried in several cases. After the first treatment the patients complained of pain in the lower abdomen, discomfort, headache, and muscular pain. Two had fever and rapid pulse. In three patients the result was good. The general health was improved, the anæmia disappeared, the number of blood-corpuscles was increased, and the menses returned. Spillmann and Etienne (*Gaz. Méd. de Paris*, No. 35, '96).

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CHOLELITHIASIS.—From Gr., *χολή*, bile, and *λίθιασις*, from *λίθος*, a stone.

Definition.—The term "cholelithiasis" is applied to that condition which results from the precipitation of cholesterin from bile and from the combination of bilirubin and lime, which form an insoluble compound. These two, cholesterin and bilirubin-calcium, make up nearly the whole mass of the biliary calculi. The calculi are of varying size and density.

The presence of concretions in the biliary passages may produce obstruction of the ducts, ulceration and perforation of the walls, and the formation of fistulous channels. The process may be accompanied by cholangitis, cholecystitis, and perihepatic abscess. Obstructive jaundice, biliary cirrhosis, and intestinal obstruction may be directly

caused by gall-stones, and can be discussed under the head of "cholelithiasis."

Physical Properties; Varieties.—Biliary calculi vary in size from that of a grain of sand to that of an English walnut or be even larger.

Case in which a conglomeration of calculi formed a mass about the size and shape of a pear, which was passed during life. The patient was a female, 60 years of age. Case also mentioned, described by Fiedler, of a stone consisting of three pieces which was over twelve inches in length and weighed forty-six grammes. It completely filled the gall-bladder. Krauss (*On "Gall-stones,"* p. 11).

The smallest (gall-sand) are dark in color and are wholly made up of bilirubin-calcium. Not infrequently a large number of small calculi, angular, faceted, and grayish in color, are found in the gall-bladder or in a sac opening into the common duct.

The larger ones are dark brown or of a dark-yellowish color, depending on the amount of bilirubin-calcium which exists in the outer layer.

When calculi are small they are usually very numerous. In one case over two thousand were removed.

[Mayo Robson has reported a case in which 728 gall-stones were removed from the gall-bladder and dilated ducts of a woman aged 54. Dr. Peters has witnessed a case (unpublished) in which 563 gall-stones were removed from a distended gall-bladder. J. E. GRAHAM.]

The larger ones exist singly or in small numbers. The shape depends on the number present. When large and single they are round or more frequently oval, but when a number exist together in the gall-bladder or in a sacculated enlargement of the bile-duct they are faceted, the result of attrition. Occasionally a single stone is found faceted: an indication that others have already passed through the ducts.

Classification.—Biliary calculi have

been classified according to the proportionate amount of their two principal constituents: cholesterin and bilirubin-calcium. They may be divided into three principal classes:—

1. Pure cholesterin.
2. Mixed cholesterin and bilirubin-calcium.
3. Pure bilirubin-calcium.

The mixed variety is altogether the most frequently met with, and cholesterin is the principal constituent.

Naunyn, whose classification is now generally adopted, makes the following division:—

1. Pure cholesterin.
2. Laminated cholesterin.
3. The common gall-bladder stones.
4. Mixed bilirubin-calcium.
5. Pure bilirubin-calcium.
6. Rarer forms.

The common gall-bladder stones are altogether the most frequent. The larger ones are about the size of a cherry, and they may be of a lemon or brownish-yellow color. When fractured, the surface presents a crystalline, glistening appearance, in which the light-yellowish color predominates. The cholesterin is arranged in layers between which bilirubin-calcium exists in greater or less quantities. The nucleus is often composed of bilirubin-calcium; broken-down epithelial cells, bacteria, and foreign bodies have been found in the centre. When very numerous, calculi in the gall-bladder are often of a light-grayish color, and consist of an outer shell and a soft nucleus.

The pigmentary, or bilirubin-calcium calculi gall-sand, are small, and are found in greater numbers than the cholesterin and mixed varieties. They are sometimes found in the intrahepatic ducts, and appear to be the result of a catarrhal cholangitis. A rare variety

of gall-stones, composed principally of calcium carbonate, is occasionally found.

Besides the constituents already mentioned, the following elements and compounds have occasionally been noted: Calcium sulphate and phosphate; copper and iron combined with bilirubin-calcium. Globules of mercury were found by Ferriettis.

Symptoms.—The symptoms of gall-stones may be studied under three heads: 1. Those produced by the passage of calculi through the natural channels. 2. Those produced by gall-stones when they have found their way outside of the gall-bladder and ducts. 3. Complications and sequelæ.

PASSAGE OF GALL-STONES THROUGH THE NATURAL CHANNELS.—Gall-stones may remain for years in the gall-bladder without producing any marked symptoms, although bile-pigment may be found in small quantities in the urine. It may, as Dr. Adler has pointed out, pass into the circulation through the base of the ulcer. It is said that the presence of calculi can be made out by palpation and percussion, but sounding for gall-stones through the abdominal walls is now almost universally condemned as being more dangerous than a laparotomy.

Krauss recently described a prodromal state of cholelithiasis. The symptoms, more marked in females, are constipation, flatulency, loss of appetite, and a sense of pressure in the epigastrium. The skin of the face first becomes pale and yellowish, then yellowish brown. The lower portion of the conjunctiva is tinged yellow. The urine is scanty and with excess of uric acid. Bile-pigment, which is at first absent from the urine, afterward appears in small quantities. Bilious headaches and migraine are important symptoms.

When a gall-stone escapes from the gall-bladder, it is usually arrested for a time in the cystic duct on account of its narrowness and of the structure of Heister's valve. In the common duct a calculus may be arrested in any part of its course, most frequently near the duodenal extremity. In the first case



The cut edges of the duodenum are stitched together, leaving a portion of the mucous membrane exposed. A gall-stone protrudes partly through the duodenal opening of the common bile-duct. (Anderson.)

biliary colic without jaundice is usually present, and in the latter colic with jaundice. It must, however, be remembered that a calculus may pass through into the duodenum without pain or any other disturbance. This usually happens when the ducts have been widened by the passage of stones previously.

Biliary Colic.—Premonitory symp-

toms—such as those of dyspepsia, a feeling of weight and distress with great restlessness—may be present. The onset is usually sudden: a severe paroxysmal pain is experienced in the gall-bladder region, radiating upward to the right or left shoulder, across or down the abdomen to the thighs. The pain is paroxysmal and increases in severity until it reaches a climax. The patient becomes more and more restless, tossing upon the bed or throwing himself from the bed to the floor, rolling about in agony. When the suffering reaches its height, vomiting may occur, which may in turn, be followed by sudden relief. Intervals of comparative ease may follow paroxysms of pain, and this may continue for hours and even days.

[Dr. H. B. Anderson, of Toronto, witnessed the case (unpublished) of a woman, aged 50, who died after six months' illness. Had deep jaundice throughout; also pruritus, with, latterly, chills, fever, and purpura. Suffered no pain. Had previous attacks of cholelithiasis with great pain, but no marked jaundice.

Autopsy showed well-marked catarrhal cholangitis. Gall-bladder thickened, distorted, and atrophied, and contained a small quantity of bile. Common duct greatly dilated, had conical-shaped calculus impacted at and partly protruding through the duodenal opening. (See wood-cut.)

On bacteriological examination, the colon bacillus was found in the blood, spleen, and liver. J. E. GRAHAM.]

The vomiting already mentioned occurs toward the end of the seizure, in a large number of cases. The contents of the stomach are first expelled, and bile follows. In some instances the vomiting may be continuous and persistent, and may itself be a dangerous symptom.

Two cases of persistent vomiting from calculi in the ducts, upon which operation was performed. In one the vomiting

continued for days after the cause had been removed. The patient, however, made a good recovery. In the second the emesis had been so persistent that the patient had to be sustained by nutritious enemata for four weeks previous to the operation. Afterward the vomiting continued for two weeks, when death took place from exhaustion. Mayo Robson (Allbutt's "System of Medicine").

The severity of the collapse varies in different cases. It is marked by cold, clammy skin, pallor, and weakness and frequency of the pulse. It has, in some instances, proved fatal. Potain mentions acute dilatation of the right heart as sometimes taking place in biliary colic.

Case of a woman, aged 47 years, who died suddenly in collapse, preceded by agonizing pain, while under treatment for hepatic colic. There was found in the abdomen a blood-clot weighing 600 grammes (20 ounces), and some sanguinolent liquid. Pauly (Lyon Méd., Jan. 24, '92).

Report of a case from heart-failure during an attack of biliary colic in a diabetic patient. Changes in the myocardium were found at the autopsy. Elsner (Med. News, Feb. 5, '98).

The presence of a tumor below the costal line indicates dilatation of the gall-bladder, which takes place in early attacks. A distended gall-bladder may occasionally exist in more or less chronic biliary lithiasis as a result of impaction of the cystic and common ducts. It is, however, more frequently found in cases of malignant disease. Enlargement of the spleen is present in some febrile cases.

Hepatic colic may also be due to a simple spasm. 1. Clinical proofs: hepatic colic is common in cases of hysteria, where no gall-stone is present. 2. Proofs from pathological anatomy: cases have been observed of jaundice and colics in which the only lesion found was contraction of the bile-duct. 3. Experimental

proofs: spasm of the lower part of the common duct can be set up in dogs. Lépine (Lyon Méd., Feb. 18, '94).

At the commencement of an attack of cholelithiasis—i.e., at a time when pain has not set in—a tumor represented by the gall-bladder is tangible. This disappears directly the gall-stone reaches the intestine. Not infrequently the pains do not at once subside; these may be caused by slight circumscribed local peritonitis in the region of the gall-bladder, and may be lessened by ice-cold compresses. Swelling of the gall-bladder may also be caused, however, by occlusion of the common duct by ascarides, *Distoma hepaticum*, or inflammatory exudations and by a tumor of the head of the pancreas pressing on the gall-duct. Gerhardt (Deut. med. Woch., Oct. 15, '93).

Catarrhal jaundice; cancer of the pancreas, gall-bladder, or ducts; cancer or tuberculosis of the liver, malaria, or cardiac disease may give rise to symptoms simulating those of stone in the common duct. G. W. Webster (Jour. Amer. Med. Assoc., June 22, '95).

Possibility of confusion between a distended gall-bladder and movable kidney. To distinguish between the two conditions it must be remembered that a distended gall-bladder, as well as the kidney, is a frequent cause of movable abdominal tumor. The range of motion in the gall-bladder is, however, always in the arc of a circle, the centre of which is a point beneath the right lobe of the liver. The history of a distinct attack of jaundice is an important factor in diagnosis. A distended gall-bladder can generally be felt, whereas a movable kidney often cannot. The gall-bladder, if distended with stones, is much harder than the kidney. Henry Morris (Brit. Med. Jour., Feb. 2, '95).

In cases of gall-stones in which biliary colic is not present diagnosis is usually not made till the autopsy. Dull pain in the region of the liver and vomiting noted in several cases. The gall-bladder is not usually palpable; it could be felt in one of the cases described, but not in the others. A. L. Benedict (Med. News, June 8, '95).

Krauss, who was himself a sufferer from biliary colic, gives the following chief symptoms:—

1. Sudden onset between two and three hours after a meal.

2. Violent, spasmodic, paroxysmal pains over the hepatic and epigastric region radiating upward over the right half of the thorax.

3. Labored respiration, feeling of distress, nausea, and vomiting.

4. Slow, hard pulse and cold extremities.

5. Sudden or gradual termination of the attack.

6. Onset of jaundice, which under certain circumstances follows the attack.

The amount of pain does not depend so much upon the size of the stone as upon its shape. A small calculus with sharp projections will cause more pain than a much larger one which is round or oval.

When the stone is arrested in the common bile-duct, similar symptoms to those already described manifest themselves, together with jaundice. It is generally thought that the pain is not so sharp or severe when the calculus lodges in the common bile-duct as when it is arrested in the cystic duct.

Icterus ensues a day or two after the commencement of the attack, and its intensity will depend upon the amount of obstruction. Bile-pigment may be found in the urine before any change is noticed on the skin or conjunctiva. In severe cases the liver may be slightly enlarged and tender and the skin of a dark-yellow color. The urine is dark and the fæces clay-colored. When the obstruction remains, symptoms of a chronic jaundice are observed, accompanied by intense itching of the skin and extravasations. Want of appetite,

foul breath, and slow pulse are symptoms often met with.

The jaundice of cholelithiasis is generally more or less intermittent in character, differing, in this respect, from that of cancerous obstruction, which is usually progressive. Jaundice may continue some days after the stone is expelled, when thickening of the wall may still cause obstruction.

The presence of bile-pigment in the blood does not appear to cause any considerable disturbance of function and in any case is only slightly poisonous. The bile-acids, on the other hand, when they enter the blood act as virulent poisons on the nervous and muscular systems and on the blood-corpuscles, as first shown by Dousche. Thoma ("Path. and Anat.," vol. i, p. 29).

[This statement is not altogether in accord with the views of Bouchard, who regarded the bile-pigment very poisonous, and who ascribed its comparatively mild effect to the fact that it is either absorbed by the tissues or rapidly given off by the kidneys. J. E. GRAHAM.]

Gall-stone attacks are frequently accompanied by fever, and in some instances the temperature may rise to 104° F. In such cases there is usually a rigor, followed by great heat of skin. The sweating stage is often absent. This has been called hepatic-intermittent, and is probably of the same character as that which sometimes follows the passage of instruments through a constricted urethra. The fever is thought to be reflex by some, but it is more probably the result of toxin absorption.

The length of time required for the calculi to find their way through the cystic and common duct varies in different cases. They may pass through so rapidly and easily that obstructive jaundice may not occur. Again, they may remain months in the ducts causing very frequently incomplete obstruction. This is

termed by some the irregular form of cholelithiasis.

In some cases the calculus floats in a distended portion of the duct, usually the ampulla of Vater, causing an intermittent or remittent jaundice.

Fenger agrees with Courvoisier that gall-stones in the common duct give rise to a series of special symptoms by which the situation can often be diagnosed with a fair amount of certainty. Some of these symptoms and conditions are:—

1. Atrophy of the gall-bladder and absence of tumor.

2. Presence of icterus, which may be (a) intermittent: complete freedom from jaundice when the calculus passes into the duodenum. (b) Remittent jaundice is usually caused by a floating gall-stone acting as a ball-valve.

3. Colic. Localization of pain outside of the gall-bladder region indicates stones in the common duct. Remittent pain is the sign of a stone floating in a dilated portion of the duct. This pain is sometimes relieved by change of position.

4. Intermittent or remittent fever.

Histories of a number of cases. In one of these the first attack of colic with icterus had occurred two years before. These attacks then became more and more frequent and were accompanied by slight remittent icterus. There was also remittent pain every two or three days for three weeks, followed by fever, *icterus gravis*, and death. The autopsy revealed one small floating stone in the dilated common duct.

In a second case the first attack of biliary colic had taken place two years previously, followed by icterus. Second attack occurred on October 24th, followed by lighter attacks, loss of weight, slight icterus, but no tumor. Operation of choledochotomy. One stone, two centimetres in diameter, was removed; no leakage; recovery. The patient gained fifty pounds in three months. Fenger (Amer. Jour. Med. Sci., p. 286, '97).

Symptoms of a gall-stone in the ampulla of Vater acting as a ball-valve. Chronic jaundice, rarely deep, varying in intensity, at times almost or entirely disappearing, to deepen invariably after a paroxysm of pain. Often a constant sense of discomfort, which may be agonizing or griping or like an ordinary liver-colic. Fever occurring in paroxysms; chills may be quotidian or tertian in type. The spleen usually enlarges with the febrile paroxysms. Although lasting for months or years, the health may not be much affected, the patient being able to work between the paroxysms. Such cases are often diagnosed as chronic malaria, abscess of the liver, or suppurative cholangitis. Osler (Lancet, May 15, '97).

PASSAGE OF GALL-STONES OUTSIDE THE ORDINARY CHANNELS.—The symptoms will depend upon the course taken by the calculus. In some instances the stone passes through the ulcerated wall, and, owing to the presence of pyogenic organisms, an abscess forms, which gives rise to symptoms similar to those of appendicitis; pain, high temperature, localized tenderness, and swelling. The abscess may open into a neighboring cavity, most frequently at the intestines, or it may extend outwardly. In other cases the stone may form a fistula with very few localized or general symptoms. Large calculi have been passed by patients which from their size must have made their way by ulceration from the gall-bladder into the intestines, although no history could be obtained tending to indicate that such a process had taken place. As a rule, however, there is more or less local pain, tenderness, and swelling.

The broncho-biliary fistula is accompanied by severe coughing and the expectoration of bile. Gall-stones have been expectorated in some cases. I have reported a case in which expectoration of bile was present three weeks and then

ceased to return; after ten years' time calculi were found in the common duct.

Sudden death has been witnessed in a case in which rupture took place into the pericardium.

Dilatation of the stomach due to inflammatory adhesions, closing the pylorus, or to the presence of a gall-stone making its way through the pylorus is attended by the usual symptoms of such a condition. Calculi have been expelled from the stomach, which have either found their way into that viscus directly, or, as is more commonly the case, have been regurgitated from the duodenum.

[The following case presents some peculiar features: The patient had been under the writer's observation for many years previous to his death. Fifteen years before he suffered from biliary colic and obstructive jaundice. A hard mass remained, which was thought at the time to be cancer. The patient recovered and the tumor disappeared. He was afterward troubled with a peculiar form of diarrhœa: awakening toward morning he had two or three watery passages, which weakened him very much. These attacks toward the close of his life became more frequent and were very distressing. The cause was supposed to be want of tone in the pylorus, which allowed undigested food to pass into the bowel. Very little of the latter, however, was noticed in the discharges. The following condition was found at the autopsy: There were many old inflammatory adhesions in the region of the gall-bladder. The latter was much contracted and dislocated. The common duct was very small.

There was a large secular dilatation of the duodenum, which formed a pouch four inches from the pylorus. The pouch was continuous with the intestine below by a valve-like orifice about the size of the pylorus. This was probably formed in the passage of the gall-stones fifteen years before, and it is probable that the contents of the stomach accumulated in the pouch and were at times discharged, producing the sudden attacks of diar-

rhœa. I am indebted to Drs. Powell and Anderson for the post-mortem notes. J. E. GRAHAM.] (Case has not been published.)

The arrest of calculi in the intestines produces at once a series of very grave symptoms of gall-stone ileus. The most prominent are sudden and severe pain; nausea; vomiting; rapid, quick pulse; with other symptoms of collapse. The mortality in such cases is very high. The lower part of the jejunum is the usual seat of the obstruction. When the stone is arrested in the duodenum, the gastric symptoms are much more marked, and, when in the lower part of the small intestine, indican may be found in excess in the urine.

Fatal case of gall-stone ileus. The patient had for a long time suffered from attacks of pain, especially when tired from standing. At the operation the stone was found, after a long search, in the small intestine and removed. It was olive shaped and weighed 400 grains. Death from collapse took place two days after the operation. Bridon (*Annals of Surg.*, Jan., '97).

Case in which a tumor existed in the pyloric region fifteen months and was generally thought to be a cancer. It was afterward shown to have been caused by an enormous gall-stone, which ulcerated through into the duodenum and brought on symptoms of intestinal obstruction. A stone (weighing 368 grains, $5\frac{1}{2}$ inches in circumference, and 3 inches long) passed with some difficulty through the rectum. It was composed almost altogether of cholesterin. Eleven months afterward the patient passed another stone weighing 240 grains. Elsner (*Med. News*, Feb. 5, '98).

Complications and Sequelæ.—The most frequent complication of cholelithiasis is catarrhal inflammation of the gall-bladder and ducts. In fact this occurs so often in the chronic form of the disease that it is generally regarded as an integral part of it. Thickening of

the walls of the ducts may take place to a sufficient extent to produce permanent obstruction and chronic jaundice. Thickening of the walls and contraction of the cavity of the gall-bladder result in atrophy.

Sometimes the process ends in a fibrous perihepatitis, and the calculus will be found imbedded in a dense mass of connective tissue. These attacks are accompanied by more or less pain and tenderness in the hepatic region and by a slight elevation of temperature.

Acute phlegmonous inflammation of the gall-bladder is a rare disease. Courvoisier described it under the term "Acute Progressive Empyema of the Gall-bladder," and collected notes of seven cases. This condition may exist when gall-stones are not present, but it is usually a complication of cholelithiasis. Typhoid and typhus fevers, malaria, and septicæmia are the usual primary diseases. The symptoms are those of a low, adynamic fever, rapid and feeble pulse, great depression, with tenderness and swelling over the right side of the abdomen. As a rule, general peritonitis supervenes and death takes place. Occasionally it terminates in a perihepatic abscess, which may be opened and a cure effected.

Pyogenic organisms may invade the gall-bladder when distended on account of obstruction in the cystic or common duct and give rise to suppurative cholecystitis and cholangitis. The patient experiences pain and tenderness in the hepatic region. A tumor more or less tender may be distinctly palpated. The general symptoms are those of fever, viz.: irregular and high temperature, rapid pulse, and great loss of strength. The symptoms of pyæmia may be present, viz.: rigors, heats, swellings, loss of appetite, nausea, vomiting, and great

depression. This fever must be distinguished from Charcot's hepatic intermittent, in which there is no pus present.

Series of 14 cases illustrating complications arising from gall-stone disease:

1. Impaction of stone in the cystic duct, followed by hydrops, empyema, and cysto-duodenal fistula.
2. Sloughing of the gall-bladder and formation of a fistula between it and the stomach.
3. Perforation of the gall-bladder and formation of a fistula between it and the stomach.
4. Impaction of stones in the hepatic and common ducts.
5. Impaction of stones in the common duct.
6. Impaction of stones in the ampulla of Vater.
7. Primary carcinoma of the gall-bladder.

When the surgeon opens the abdomen for gall-stone disease he must be prepared to meet and deal with any complication, and complications are met in from 20 to 30 per cent. of all gall-stone operations. Moynihan (*Brit. Med. Jour.*, Nov. 8, 1902).

Suppurative cholangitis presents the same general symptoms, but no tumor is felt, and the enlargement of the liver is more marked. Great tenderness may exist over the hepatic surface. Persistent jaundice is a constant and marked symptom.

As described by Naunyn, hepatic abscess may arise from cholelithiasis in several different ways:—

1. An empyema of the gall-bladder may burst into the liver.
2. Purulent cholangitis of the intrahepatic ducts leads to ulceration, which may exist in different places in the liver.
3. The hepatitis sequestrans of Schüppel.
4. Metastasis or embolic abscess.

Ulcerative endocarditis may arise from infection entering the circulation through the walls of the gall-bladder or ducts.

[The following case, an example of this, was seen by the writer, who is in-

debted to Dr. H. A. Bruce, the attending surgeon, for the notes here given: Mrs. A., aged 45, suffered fifteen years from recurring attacks of biliary colic. During last attack pyæmia developed, which ended fatally. Post-mortem: the bacillus coli communis was found in the heart's blood. Aortic valves were ulcerated and covered with vegetations. Gall-bladder contained six stones and its mucous membrane showed ulceration, through which it was thought the bacilli had gained entrance to the circulation. There was no evidence of cholangitis. J. E. GRAHAM.]

Hæmorrhage is a complication which may occur as a result of the action of biliary toxins on the blood. Gastric and intestinal hæmorrhage may arise from this cause or from ulceration into the blood-vessels. Intestinal hæmorrhage may also be caused by passive congestion, the result of thrombus of the portal vein due to the pressure of biliary calculi. Naunyn has not observed copious hæmorrhages from this cause.

Perforation of the gastric or intestinal mucous membrane is an occasional cause of hæmorrhage. The writer has observed two cases in which he concluded from the history that hæmorrhage had arisen in this way; but he was not able to verify his conclusions.

In Aufrecht's case, quoted by Naunyn, a large stone had partially broken through from the gall-bladder into the hepatic tissues; this led to severe hæmorrhage, and the blood had entered the gall-bearer and thence had flowed into the intestine along the cystic and common ducts. Ulceration of the portal vein and aneurism of the hepatic artery may also cause fatal hæmorrhage.

Diagnosis.—The diagnosis of the form of biliary colic produced by the arrest of gall-stones in the cystic duct is often difficult. The unbearable, cutting, tearing, paroxysmal pain seated in the gall-

bladder region and radiating to the right or left shoulder is an important characteristic. The presence of a tumor in the hepatic region, after an attack, of the characteristic shape of a distended gall-bearer is a confirmatory sign.

Of the conditions from which it is to be differentiated, the most frequent are: neuralgia, pleurisy, gastric colic, intestinal colic, and appendicitis.

General diagnostic symptoms of cholelithiasis may be, primarily, pain, nausea, vomiting, jaundice, ashen-colored stools, high-colored urine, tenderness over the region of the liver, tumor, and nervous phenomena. Collectively, they establish the diagnosis. Separately, they may be found in other diseases of the biliary apparatus and surrounding viscera. W. J. Means (Jour. Amer. Med. Assoc., Dec. 1, 1900).

PLEURISY.—The presence of pleurisy may be made out by careful physical examination.

NEURALGIA.—The painful points of neuralgia should be looked for.

GASTRIC COLIC, especially that form in which there is a spasmodic painful contraction of the pylorus, is very difficult of differentiation. When the pains rapidly follow, for instance, the taking of cold water and the symptoms are prominently of a gastric character, the condition may be recognized as one pertaining to the stomach and not to the liver.

INTESTINAL COLIC.—In intestinal colic the seat of pain and the character of the latter differ from those of biliary colic. Chills and fever accompany biliary more frequently than gastric or intestinal colic.

ACUTE APPENDICITIS.—The differentiation of acute appendicitis is sometimes very difficult, especially in cases in which adhesions to the under-surface of the liver follow an attack. Differ-

ence in the seat of pain in first attack is nearly always marked.

In biliary colic the pain often radiates upward to the shoulder, while in appendicitis it is experienced in the region of the umbilicus.

In the writer's experience, it is of the greatest importance to note down accurately the history of the case and to observe whether the symptoms are hepatic, renal, or intestinal. A careful examination into the clinical history is of almost as much importance as are the physical signs.

The presence of gall-stones in the fæces is the crucial test in the diagnosis. These may escape observation unless great care is taken in the examination. The stools should be made as fluid as possible by the addition of water and passed through a fine sieve. The principal points in the diagnosis of chronic cholelithiasis are the attacks of pain more or less severe in the hepatic region, tenderness of the liver, the presence of a tumor resulting from perihepatic inflammation or abscess, exacerbations of fever with or without local pain; jaundice, usually intermittent or remittent; not often persistent and increasing.

The differentiation between a distended gall-bladder and a displaced right kidney is often difficult. It is not infrequently impossible to make a distinction by noting the shape and size of the tumor; occasionally all the methods generally laid down, such as the movements of the gall-bladder by respiration, the limitation of its movements, and the relative situation of the colon, are all of little use. Sometimes by careful palpation the kidney and gall-bladder can be separated and a positive diagnosis made.

Number of cases in which gall-stone crepitus was made out and proved to be

of great diagnostic value. The crepitus may be obtained by palpating with the finger-tips dipped gently, but deeply, in the abdominal wall just below the fundus of the gall-bladder and then drawn upward over the organ as though making an attempt to roll the fundus upward and forward. Deep inspiration is helpful and the tactile sense of the palpating fingers may be increased by pressing on their dorsal surfaces with the disengaged hand. Auscultation is sometimes successful when palpation fails, and a combination of the two has led to the detection of a friction-sound. In attempting the latter mode of examination the stethoscope should be placed just below the costal arch, in order to allow space for the palpating right hand over the fundus of the gall-bladder. J. M. Anders (Inter. Med. Mag., '99).

Palpation for the lower margin of the liver should be conducted in the following manner: The physician, seated to the right of the recumbent patient, places the left hand flatly on the abdomen in the hepatic region, and endeavors by means of gentle pressure with the tips of the fingers to ascertain the situation of the lower edge of the liver. When he thinks he is near to the liver's edge, the fingers of the right hand are placed obliquely upon the left (the right index finger corresponding to the left little finger, and *vice versa*) in such a manner that the tips of the fingers of the right hand slightly overhang those of the left. Firm pressure is exercised with the right hand upon the subjacent passive left.

If by means of this "octodigital" palpation the liver-edge cannot be felt in the right mammary line, there is no hypertrophy of the organ.

If the liver is enlarged—especially if its volume presents manifest fluctuations from time to time, augmenting during the attacks of pain and diminishing in the intervals—and in addition abdominal tenderness is found to be present, a diagnosis of hepatic colic may be made. Pol-latschek (La Semaine Méd., Apr., '99).

If after a careful examination into the history and present condition, especially

an analysis of the urine, the symptoms and signs are found to be hepatic rather than renal, the tumor will probably be a distended gall-bladder. As before stated, a displaced kidney attached to the under-surface of the liver may cause jaundice by drawing the common bile-duct out of place.

When anatomical conditions are favorable, disease of the pancreas may occur as a complication of cholelithiasis when a calculus passes along the common bile-duct. The lodgment of a stone near the orifice of the bile-duct where it may at the same time compress and occlude the duct of Wirsung, is not uncommonly a cause of pancreatic lesions and disseminated fat-necrosis. Should a calculus become impacted in this position, one of several conditions may result:—

1. An individual, usually in fairly good health, with perhaps a history of previous gall-stone colic, is suddenly attacked with pain in the epigastric region, accompanied by vomiting and followed by collapse. Death follows usually within forty-eight hours, and at autopsy gall-stones are found in the bile-passages, while that one which caused the fatal attack may be still lodged in the common duct near its orifice. The pancreas is enlarged, infiltrated with blood, and hæmorrhage may have occurred into the surrounding tissue. Foci of fat-necrosis are usually present.

2. A fatal termination may not follow rapidly the symptoms mentioned. Pain in the epigastrium persists, jaundice may be present, and a tumor-mass above the umbilicus may indicate a probable lesion of the pancreas. At the end of one or more weeks or months death occurs, often with symptoms indicating the presence of suppurative inflammation, presumably in the neighborhood of the gland. At autopsy the diagnosis of cholelithiasis is confirmed by the presence of gall-stones in the gall-bladder or in the bile-ducts, and occasionally the offending calculus is still lodged near the junction of the com-

mon bile-duct and the duct of Wirsung. The pancreas is dry, black, and necrotic, and evidence of previous hæmorrhage may be present. Secondary infection has occurred, and the pancreas lies in an abscess-cavity formed by the bursa omentalis. In the wall, and often widely disseminated in the abdominal fat, are foci of necrosis. Since the individual has survived the primary lesion, opportunity has been given for the development of secondary changes in the injured pancreas and neighboring fat.

3. In certain instances long-continued or repeated obstruction of the pancreatic ducts by gall-stones does not cause the acute lesions described, but produces chronic inflammatory changes. E. L. Opie (Amer. Jour. Med. Sci., Jan., 1901).

A distended gall-bladder may require to be differentiated from pyloric and intestinal carcinoma, fæcal impaction in the colon, tumor of the liver and of the right kidney; also from a tongue-like projection of the liver, which is occasionally found.

Attention called to cases of acute cholecystitis of sudden onset in patients of apparently perfect health, in which there is no history of gall-stones and which do not depend on typhoid fever, pneumonia, or other infective processes. Of 59 cases of cholecystitis personally operated on only 10 began without known pre-existing disease. Three of the 10 cases were diagnosed as acute appendicitis with such certainty that the incision was made over the appendix. In 3 the symptoms were those of acute intestinal obstruction.

Again, the disease may be mistaken for the sudden closure of an organic stricture, for an inflammatory process in a diseased kidney, an acute peritonitis, an acute pancreatitis, an extravasation from the stomach, a malignant abdominal tumor, or a tumor with a twisted pedicle.

If the symptoms point to the gall-bladder rather than to the appendix the incision should be made over the former and *vice versa*. When there is great

doubt as to which is affected, the cut may be made behind the cæcum, high up and enlarged in whichever direction is required. When there is no localized pain or tumor or history pointing to a definite lesion, the incision should be in the middle line.

Seven of the 10 cases recovered. Richardson (*Amer. Jour. Med. Sciences*, June, '98).

There are three prominent symptoms of cholelithiasis in infancy and in childhood upon which the diagnosis is often based, namely: pain, vomiting, and convulsions. Pain is usually referred to the epigastrium and is indicated in children by paroxysms of crying attended with severe vomiting. One of the most valuable diagnostic signs is persistence of the sensitiveness of the gall-bladder after cessation of the symptoms of the colic. The best means of eliciting this symptom is by placing the child in a warm bath, which will serve to distract its attention and at the same time relax the muscular structures. The Rentini symptom, pain around the xiphoid cartilage from gall-stones during their expulsion, is deserving of particular attention. Vomiting is usually persistent.

Fever, chills, costal respiratory movements of a jerky character when the patient is placed in a sitting posture, are some of the other symptoms that aid in establishing the diagnosis. In young persons jaundice caused by gall-stones without pain is rare. In doubtful cases the urine should be evaporated on a water-bath to about one-tenth its original volume and tested for biliary coloring-matter and biliary salts. Acholic fæces in children are not necessarily white; frequently they present a greenish color, with putrid odor and diarrhæal tendencies. A. V. Wendel (*Med. Rec.*, July 9, '98).

Number of successful radiographs of gall-stones obtained. The longer the time of exposure, the clearer the liver and the more obscure the calculi. About five or six minutes gives the best results. The patient should lie upon the abdomen with a pillow underneath his symphysis and clavicles. The rays shall not penetrate the abdomen in a vertical di-

rection, but should form an angle of about 45 degrees with the plate. A great deal also depends upon the composition of the stone, which is far more complex than that of renal calculi. Calculi consisting of pure cholesterin give but an indistinct shade, while those containing quantities of calcium are well shown. Calculi which consist of a compound of calcium and bilirubin, or carbonic acid, are distinctly brought out by the rays. Carl Beck (*N. Y. Med. Jour.*, Jan. 20, 1900).

Prognosis.—The presence of calculi in the gall-bladder is not of so much importance when they do not give rise to any pronounced symptoms; but in all cases they are to be looked upon as foreign bodies which may at any time give rise to dangerous symptoms. When phlegmonous inflammation of the gall-bladder takes place, the prognosis is grave.

Biliary colic is not always free from danger. Some cases of death from heart-failure have been recorded. Distended gall-bladder from calculous obstruction of the cystic duct when accompanied by elevation, and irregularity of temperature, with local pain and tenderness, suggests the possibility of suppuration. Cholecystitis may result in rupture of the gall-bladder or in general septicæmia. Both conditions usually terminate fatally.

Hepatic and perihepatic abscesses are of grave import. The prognosis of jaundice depends on the amount of obstruction and the previous health of the patient. If the jaundice is intermittent or remittent, as is the case when a calculus floats in an enlargement of the common duct, the danger is not great, because the system will eliminate the poison in the interval.

If the patient have a poor constitution or if the kidneys are diseased; a moderate amount of jaundice may prove

serious. The grave symptoms of jaundice are a slow pulse, lethargy, and the occurrence of hæmorrhages through the mucous membrane or into the tissues.

Gall-stone operations in jaundiced cases are much more hazardous than those done when that condition is absent.

The prognosis of cholelithiasis is much more favorable since the development of hepatic surgery, and the experience of the last two or three years would seem to indicate that it is possible to remove calculi in the most difficult cases with comparative safety if the patient be not allowed to become too much poisoned by the toxins of bile and by those resulting from membranous infection.

Etiology.—Biliary calculi have been found at all ages, even in newborn children. The fact is well established that cholelithiasis increases in frequency with advancing years. According to Schroeder's statistics as given by Waring, gall-stones were present in the following percentages of cases:—

Under 20 years, 2.4 per cent.

Between 20 and 30 years, 3.2 per cent.

Between 30 and 40 years, 11.5 per cent.

Between 40 and 50 years, 11.1 per cent.

Between 50 and 60 years, 9.9 per cent.

Over 60 years, 25.2 per cent.

Krauss found in actual practice that gall-stones diagnosed by symptoms during life occurred most frequently in men between the 40th and 60th years, and in women between the 30th and 50th years. Recklinghausen's statistics of autopsies made between 1880 and 1887 give the percentage of all stones: 4.4 per cent. of men and in 20.6 per cent. of women.

Of 93,000 patients examined, stones

were noted in only 133, making 0.14 per cent., while, on the other hand, at autopsies fully 10 per cent. of the bodies are found to possess them if a careful examination of the biliary system is made. The great frequency with which gall-stones are not diagnosed *intra vitam* is thus shown. The Roentgen rays may be looked upon as a valuable diagnostic aid in the future, and already a number of excellent photograms have been published. Best results will always be obtained with the strongly calcareous stones, while the rarer ones, consisting chiefly of cholestrin or bile-pigment, can hardly be expected to throw a shadow. H. Fiedler (Münchener med. Wochen., Oct. 22, 1901).

Pending the study of other series of cases from various parts of the United States, one may draw the following conclusions:—

Nationality: On the basis of the analysis of the 1655 autopsies from the Johns Hopkins Pathological Department, as compared with 1150 (?) cases as given by Schröder, of Strassburg, gall-stones are less frequent in the United States than in Germany, the United States showing a frequency of 6.94 per cent.; Germany, of 12 per cent.

Age: The frequency of gall-stones in a given number of cases will increase with the age of the patients examined. The American cases tend to confirm the statements of previous observers that gall-stones are rare before the thirtieth year and more frequent after that age.

Color: Gall-stones are more frequent in the white man than in the black, the American cases showing a frequency of 7.85 per cent. in the whites and 5.51 per cent. in the negro.

Sex: Women are more liable to have gall-stones than are men, the American cases showing the frequency in 618 women to be 9.37 per cent., and in 1037 men to be 5.94 per cent. The American women have gall-stones only about half as frequently as the German women. In the United States only about 1 woman in every 10 has biliary calculi, while in Germany, according to Naunyn, gall-stones are found in 20.6 per cent., or in about 1 woman in every 5. C. D.

Mosher (Johns Hopkins Hosp. Bull., Aug., 1901).

In women the largest number of cases occur in the child-bearing period, and, according to Schroeder, 90 per cent. of the females were women who had borne children. The fact that cholelithiasis occurs in females in the proportion of 4 or 5 to 1 of males is established by all statistics. Tight-lacing has been given a very prominent place in the causation by some authors. In more than half of the female cases the liver has shown signs of pressure of the ribs.

A pendulous abdomen is often found, which may favor the formation of calculi directly in causing a partial obstruction of the bile by traction on the common bile-duct.

Langenbuch is of the opinion that the traction of a displaced right kidney on the common duct is a predisposing cause of cholelithiasis to which sufficient importance has not been given. The capsule is attached to the cystic duct, the hepatico-duodenal being continuous with the hepatico-renal ligament.

As profession and social position as causative factors, Krauss gives the following statistics of 472 cases in men which came under his observation:—

Physicians, 45.

Officials, 74.

Manufacturers, 19.

Clergymen, 60.

Large landed proprietors, 24.

Merchants and bankers, 40.

Small land-owners, 26.

Military officers, 20.

Professors and teachers, 103.

Tenants, 41.

Over 50 per cent. occurred in active brain-workers who at the same time lead sedentary lives. Krauss gives mental anxiety, chronic constipation, and frequent pregnancies as probable causes.

He is also of the opinion that the deposit of fat in the abdomen prevents the active peristalsis of the intestines.

Heredity does not seem to play an important part. Naunyn claims that it would be difficult to estimate this factor in a disease so prevalent. In 60 per cent. of Krauss's patients the disease could be traced in the families of the patient. He has often treated mothers and daughters for cholelithiasis at the same time.

Gout has been looked upon as a predisposing cause. It may act in two ways: by producing a stagnation of bile in one who cannot take sufficient exercise, and by means of toxins which, when excreted by the liver, may bring about a catarrhal inflammation of the ducts.

The relation between diabetes and cholelithiasis has given rise to much discussion. Bouchard found gall-stones present in 165 cases of diabetes. Mayo Robson states that they are rarely found in case of diabetes when nitrogenous food is largely taken.

Cardiac disease tends to the formation of calculi by rendering the patient incapable of much exercise, and by causing passive congestion of the liver. Brockbank found gall-stones in 27 out of 49 cases of heart disease.

Renal calculi were found so frequently in gall-stone cases that a definite relationship was thought to exist between the two conditions. On the other hand, Naunyn has rarely found the two diseases combined.

A villous condition of the inner surface of the gall-bladder has been given as a predisposing cause.

It is generally thought that cancer, with which cholelithiasis is so frequently combined, is caused by irritation of the calculi. It would, however, seem probable that roughening of the surface,

catarrhal cholecystitis and cholangitis, which frequently occur in the early stage of the disease, as well as the partial obstruction which must often take place, would all predispose to the formation of calculi.

Gall-stones probably form around a nucleus of precipitated bile-salt resulting entirely from local changes. The calcium salts and bile-pigments are readily precipitated whenever there is an increase in the albuminous constituents of the bile, and this increase is particularly marked when inflammatory changes occur in the bile-passages. Cholesterin is especially abundant when any degenerative process is going on, as there would be in disease of the gall-ducts, and this cholesterin is deposited around the nucleus. The most frequent causes of such catarrh is infection by micro-organisms, the bacilli coli communis and the typhoid bacilli being particularly apt to originate such disturbances. The latter may have laid dormant for many years before acting as an exciting agent. W. H. Thomson (New York Med. Jour., March 1, 1902).

The relation which insanity bears to cholelithiasis has long excited interest. The more frequent occurrence of gall-stones in insane people is probably due, in large measure, to their sedentary habits. The opinion has also been given that great nerve-waste may produce an excess of cholesterin.

Sedentary habits are, no doubt, a very important predisposing cause. The flow of bile, which under ordinary circumstances takes place under very low pressure, is much influenced by the movements of the body and especially by the movements of the diaphragm. When, therefore, the body is in complete repose, stagnation of the bile will more readily take place, and the soft cholesterin masses which form the nuclei of gall-stones do not pass out of the gall-bladder, but are coated by a more

dense layer of cholesterin or bilirubin-calcium, and thus become too large to pass through the cystic duct. Conditions which interfere with the movement of the diaphragm—such as empyema and pregnancy—have the same effect.

Authoritative views with regard to the influence of diet have been divided, and of late years its importance has been much doubted. Experience has shown that, in cases of biliary fistula, farinaceous and saccharin food will produce a dense, thick bile, whereas an albuminoid diet will cause the biliary secretion to be more liquid. A dense, thick bile will act in the same way as if it were stagnant: in favoring the formation of calculi. Frerichs thought that a small number of meals, with too long an interval between them, prevented the proper emptying of the gall-bladder, and thus predisposed to the formation of calculi.

It was at one time thought that too much lime in drinking-water predisposed to cholelithiasis; this has, however, not been substantiated. Climate does not seem to have any great influence.

A summary of our present knowledge regarding the etiology of cholelithiasis shows that gall-stones may originate either in the gall-bladder or in the intrahepatic ducts. In a large majority of cases they occur in the former situation and are the result of catarrhal and other inflammations. The formation of bilirubin calculi in the intrahepatic ducts is caused by catarrhal inflammation, probably the result of the excretion of some irritating substance. It is possible, also, that a microbic invasion may take place either through the common bile-duct or from the blood-vessels; but the latter is not likely. Bilirubin-calcium calculi may form in the intrahe-

patie ducts and pass through into the gall-bladder, becoming the nuclei of larger stones.

The principal predisposing cause is the stagnation of bile, and this may arise either from its inherent density or from partial obstruction. In the various predisposing conditions given it will be found on examination that they all act in the same way, viz.: in lessening the pressure of the flow of bile through the common duct. It is not impossible that chemical conditions, such as have been described by Thudicum and the French writers, may underlie the formation of calculi, but certainly the existence of such conditions has never been demonstrated.

Typical calculi produced in guinea-pigs and following results obtained: Foreign bodies when introduced into the gall-bladder can stay there for an indefinite time, provided they are aseptic, without causing inflammation or precipitating the solids from the bile. When the foreign bodies are previously impregnated with virulent micro-organisms, however, they cause a more or less intense cholecystitis and precipitate the solids from the bile. As long as the bacteria retain their virulence they cannot form a calculus, but only a sediment mixed with pus. This precipitate has no tendency to cohere or to adhere to foreign bodies. Five or six months are required for the formation of a perfect calculus. The kind of bacteria injected seems to be of quite secondary importance. Mignot (*Arch. Gén. de Méd.*, Aug., '98).

Biliary calculi may be caused by cholesterin, bilirubin calcium precipitated by changed reaction, bacteria of various types, and foreign bodies. Gall-stones are uncommon in childhood, rare under thirty, somewhat common between thirty and sixty, usual after sixty years. Females suffer from them in the ratio of 4 to 2. Anything predisposing to stasis is a potent cause. The bacillus coli communis and bacillus typhosus are the most potent generators of biliary calculi.

F. C. Shattuck (*Phila. Med. Jour.*, Oct. 6, 1900).

Pathology.—FORMATION OF CALCULI.

—Cholesterin, the principal constituent of biliary calculi, is constantly found in the bile, being kept in solution by the biliary-acid salts: the glycocholate and taurocholate of soda. It is not found in the blood, nor in the liver, unless there be necrosis of the hepatic cells. It must, therefore, be produced by the epithelial lining of the bile-ducts and gall-bladder. Its precipitation will depend either upon its increased proportion in the bile, or upon the diminished solvent power of the latter fluid. Where both conditions exist together, the process of concretion is still more favored.

Although the quantity of cholesterin in the normal bile is fairly constant, it may be considerably increased by inflammation of the mucous membrane of the gall-bladder and passages. The same condition produces a lessened alkalinity of the bile, which diminishes its solvent power. It is thus seen that catarrhal inflammation at once produces the two conditions favorable to the precipitation of cholesterin. The process may be set up by such germs as the colon bacillus, the typhoid bacillus, and the pneumococcus. The fact that such organisms have been found in the nuclei of calculi confirms the theory of this method of their origin, which was elaborated by Naunyn in his work published in 1892. The presence of a nucleus of bilirubin-calcium or cholesterin is not of itself sufficient to give rise to a calculus. This has been proved by experiments upon dogs. Cholesterin calculi, according to Naunyn, may form in two ways: either with small cholesterin masses as nuclei, or small aggregations of sediment become the centre of calculi. This sedi-

ment consists of brownish particles and yellow, gritty masses in which fat-granules and cholesterin crystals are often present.

A comparatively-soft nucleus may be surrounded by a hard layer of cholesterin. When a calculus is once formed it increases in size, layer upon layer. The crystallization of the cholesterin takes place within the calculus after its formation.

The portal of entry of the micro-organism is probably the duodenal opening of the common bile-duct. It is also probable that, in the great majority of cases, the germs pass into the gall-bladder and not into the intrahepatic ducts. The possibility of entrance through the blood-vessels must be allowed, but has not been proved.

Naunyn is of opinion that the colon bacillus is the principal agent in the production of calculi. Within the last few years the relationship between typhoid fever and cholelithiasis has been studied by Osler, of Baltimore; Hunter, of London; and others. The frequency with which the latter disease follows typhoid, and the fact that Eberth's bacillus has so often been found in the gall-bladder of those who die of typhoid fever, are interesting facts in this connection.

1. The microbic theory of gall-stones which was promulgated ten years ago is now an established fact.

2. It is probable that the micro-organisms favor the precipitation of certain elements of the bile, but the microbes cause a catarrh, which may not be recognized clinically. The degeneration of the epithelial cells produces the cholesterin and lime. The latter combines with bilirubin to form the insoluble bilirubin calcium.

3. Lithiasis is a result of the infection of the whole biliary tract or of the gall-bladder alone.

4. Calculi may be divided into two classes: those produced by the colon and those by the typhoid bacilli. The colon bacillus is the most frequent cause. Fournier (*Origine Microbienne de la Lithiase Biliaire*, Paris, '96).

Cholesterin is not wholly of local origin as claimed by Naunyn. R. H. Chittenden (*Med. News*, May, '97).

Conclusions arrived at, largely from experiments upon animals:—

1. The presence of aseptic foreign bodies in the gall-bladder does not produce inflammation and does not seem to affect its function, if the cystic duct remain patent. There is no precipitation of cholesterin when the bile remains clear and free from microbes.

2. Bile stagnant in an aseptic gall-bladder has no tendency to precipitate.

3. There is greater tendency to precipitation when the infection is from an attenuated, than from a strong, virus. R. Mignot (*Thèse de Paris*, '96).

Naunyn's theory that gall-stones are the result of catarrhal inflammation of the lining mucous membranes not accepted. In most cases they result from a decomposition of the bile into simpler substances, such as are produced more particularly during the process of so-called spontaneous decomposition after its removal from the body.

Those who look at the formation of gall-stones as simply the result of local changes, and do not study the general constitutional conditions which give rise to them are like those of whom Stroe-mer speaks: "They hear the little grass grow while the thunder rolls unobserved in the upper ether." J. L. W. Thudicum (*Med. Press and Circular*, vol. lxiv, 208-210, '97).

Epithelial degeneration and the presence of albumin are purely of a local character and are the result of catarrhal and other inflammations of the gall-bladder and bile-ducts. Two etiological factors recognized of catarrh: 1. Infection of the gall-bladder with micro-organisms, the two most frequently found being bacillus coli communis and the typhoid bacillus. 2. Excretion of irritant substances through the bile which cause a catarrh of the intrahepatic ducts in



Gall-Stones Crystallized around sutures. (Homans.)

ANNALS OF SURGERY.

which the bilirubin-calcium calculi are formed. These latter may afterward find their way into the gall-bladder. The lime, which is rapidly formed in the catarrhal process, combines with the bilirubin to form a substance insoluble in bile. William Hunter (Brit. Med. Jour., Oct. 30, '97).

Experimental formation of gall-stones. Three drops of a culture of typhoid bacilli were injected in the gall-bladder of a rabbit. At the autopsy, six weeks afterward, two small calculi about the size of grains of wheat were found in the gall-bladder. They were made up of a whitish kernel inclosed in a dark-colored shell. A pure culture of typhoid bacilli was made from the nucleus of one of them. Gilbert and Fournier (Deutsche med. Woch., Dec., '97).

Case of formation of gall-stones around sutures allowed to remain in the gall-bladder after a cholecystotomy. The gall-bladder was entirely emptied of stones in April, 1895, and in January, 1897, several round and oval calculi were found. Sutures formed the nucleus of each. (*See colored plate.*) John Homans (Surg. Annals, July, '97).

The simple presence of organisms in the gall-bladder does not seem sufficient to set up inflammation of the mucosa nor to produce cholelithiasis. Some other factor, presumably some form of irritation, such as traumatism or some hindrance to the proper evacuation of the gall-bladder, is essential. Cushing (Johns Hopkins Hosp. Bull., Aug.-Sept., '99).

Predisposition to gout and rheumatic disorders regarded as largely concerned in the production of gall-stones. If the bacterium coli commune is a cause, it is on account of its producing a catarrhal condition of the intestinal tract. W. L. Carr (N. Y. Med. Jour., Apr. 22, '99).

Bilirubin-calcium is insoluble in water, and cannot be formed simply by concentrating the bile. It has been found that egg-albumin will aid in the precipitation of bilirubin-calcium from bile. It is probable that albumin may act similarly in pathological processes.

Formation of biliary calculi does not take place solely in the gall-bladder. Some are formed in the ramifications of the hepatic duct. Cholesterin and calcium (bilirubinate of lime), the chief chemical constituents of biliary calculi, come from the mucous membrane of the biliary ducts. Lithogenic catarrhs of the mucous membrane may be excited by microbes (*coli bacillus*, Eberth's bacillus, possibly also by others). Great virulence of the germs is by no means favorable to the formation of concretions. Slight infections may become developed as soon as there is stagnation of bile. Naunyn (Intern. Med. Congress; Brit. Med. Jour., Sept. 29, 1900).

The formation of bilirubin-calcium stones, as has been already intimated, takes place in the intrahepatic ducts. Naunyn and others are of opinion that the calcium results from an inflammation of the lining membrane of the ducts, from the presence of microbes. It would seem difficult to understand how micro-organisms find their way from the duodenum into the smaller bile-ducts, and still more difficult to conceive of their entering the intrahepatic ducts from the blood without seriously affecting the parenchyma of the liver. As has been already noticed, William Hunter, of London, is of the opinion that calculi of the intrahepatic ducts is caused, not by micro-organisms, but by toxins excreted by the liver. The function of the liver as an excretory organ has been amply proved by Schiff and others, and a catarrhal inflammation from this cause seems reasonable.

Spontaneous fracture of biliary calculi sometimes takes place.

The view that spontaneous fracture might arise from an invasion of microbes expressed by some members. Discussion in the London Pathological Society (Brit. Med. Jour., Nov. 20, '97).

MORBID ANATOMY.—The gall-bladder may be distended with calculi and little

change found except erosion of the mucous membrane, with more or less thickening and infiltration in places. Cholecystitis and pericholecystitis may cause these changes to be more pronounced. Phlegmonous inflammation of the gall-bladder sometimes occurs in acute diseases.

Calcification of the gall-bladder sometimes follows empyema, in which the mucous membrane may be coated or the whole thickness of the wall may become infiltrated with lime-salts.

Distension of the gall-bladder usually arises from the arrest of calculi in the cystic duct. The contents in uncomplicated cases are largely composed of mucus, more or less bile-stained: hydrops felleæ. If at the same time there is an invasion of pyogenic organisms, an empyema of the gall-bladder results.

Ulceration and perforation sometimes occur, allowing the contents of the gall-bladder to pass into the peritoneal cavity.

Two cases of distension of the gall-bladder from flexion of the neck. No gall-stones were found. A. H. Ferguson (Brit. Med. Jour., Nov. 6, '97).

Fatal case of rupture of the gall-bladder. Patient 26 years of age. The gall-stones found their way out of the gall-bladder partly by ulceration and partly from expulsion. Some gall-stones and bile-stained fluid were found in the abdomen, together with the results of general peritonitis. A perforation of the rectum, which allowed fæces to pass out, was also discovered at the post-mortem. The perforation thought to have been caused by pressure of gall-bladder stones on the peritoneal coat of the bowel. The patient lived twenty-five days after the rupture of the gall-bladder. Shadbad (St. Petersburg med. Woch., Jan., '96).

FISTULÆ.—Gall-stones may pass out through the wall of the gall-bladder or ducts into the surrounding structures,

producing fistulæ, which may take different directions.

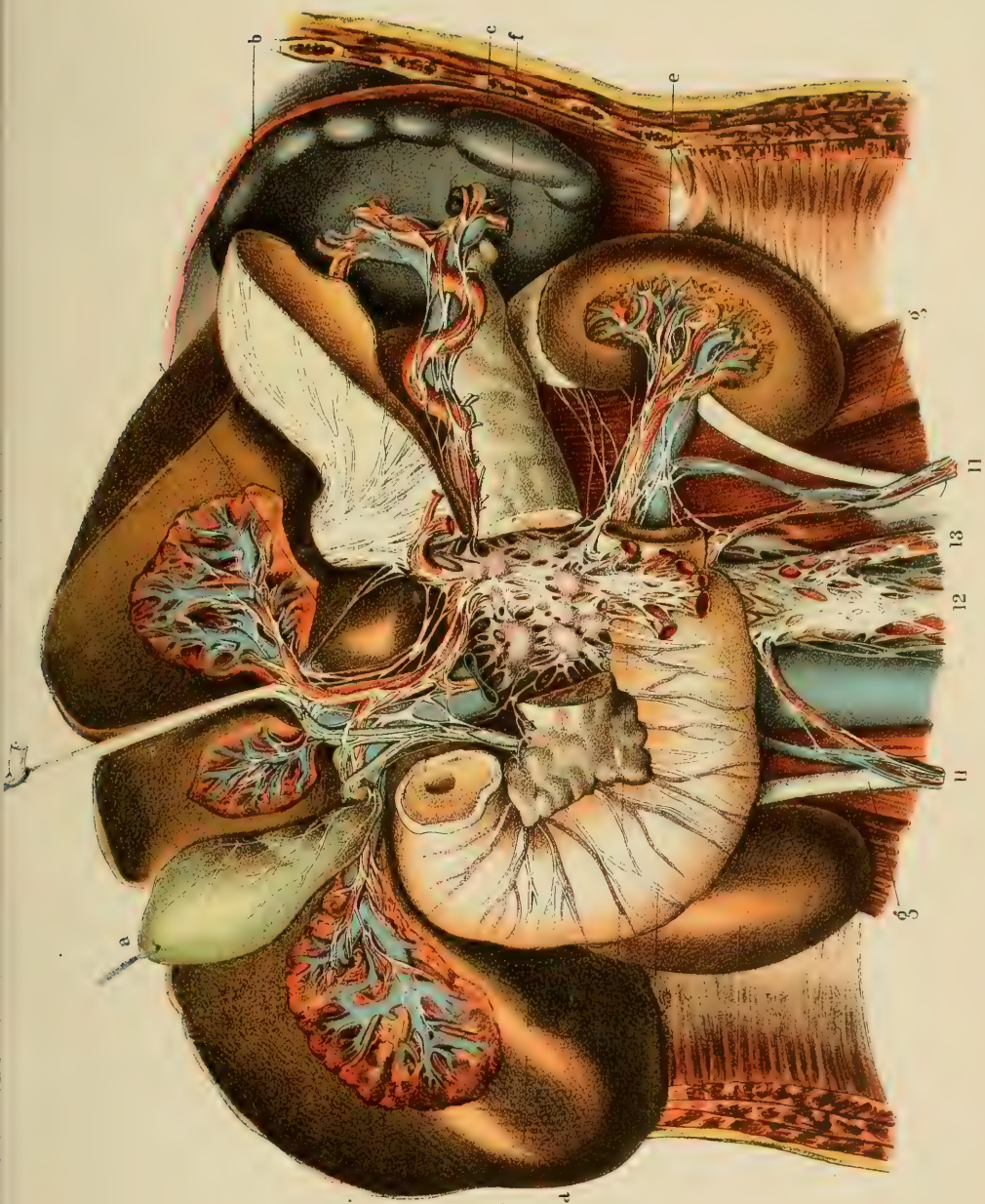
In hepatico-bronchial fistulæ a series of cases of this rare form of disease studied by the writer showed that the opening through the diaphragm into the gall-bladder may arise from a distended gall-bladder passing over the anterior border of the liver, or that calculi could find their way by ulceration through the wall of the gall-bladder and ducts, forming an abscess which may penetrate the convex surface of the liver and the diaphragm. In such cases a cavity is often formed by the presence of intrahepatic calculi and of pyogenic organisms. A direct fistulous opening may take place between the gall-bladder and the stomach.

Case of obstruction of the pylorus produced by a gall-stone and surrounding inflammatory adhesions. There was a direct communication between the gall-bladder and stomach, a cystico-stomachal fistula. Monprofit (Bull. de la Soc. d'Anat. de Paris, May, June, '97).

Fistulous openings into the duodenum or through the abdominal walls are the most common. In the latter case openings may take place in the right hypochondrium, near the umbilicus and above the pubes.

Interesting case of biliary fistula into the urinary tract. The post-mortem revealed a fistula leading into an abscess and from this into the pelvis of the right kidney, where a large cholesterol calculus was found. Elsner (Med. News, Feb. 5, '98).

Courvoisier has reported seven cases of urinary fistulæ. Cases of fistulæ into the uterus and vagina have also been reported. The chronic irritation resulting from the presence of calculi in the gall-bladder and ducts may give rise to atrophy or calcification of the gall-bladder and to the formation of diverticula and cicatrices. Thickening of the



Relation of Gall Bladder and Bile Ducts to other organs.

(The Liver is raised.)

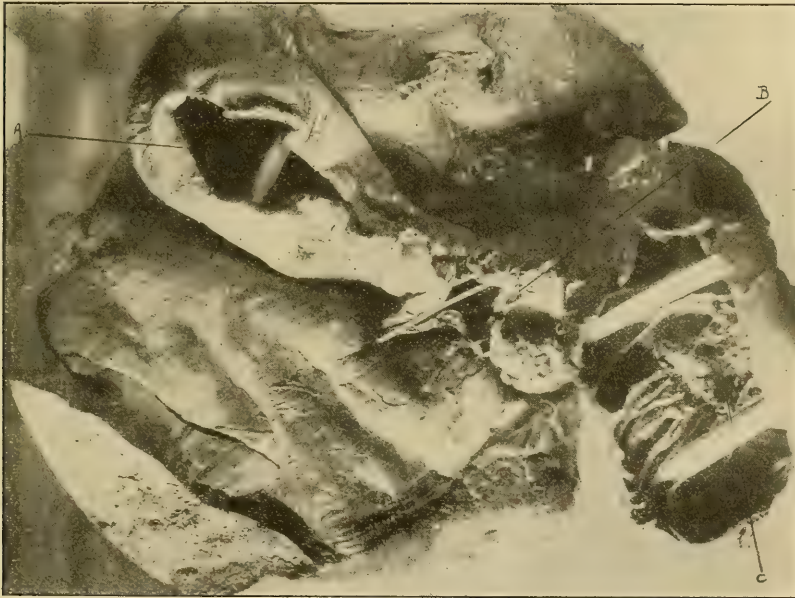
a Gall-Bladder, b Stomach, c Spleen, d Liver, e Kidney, f Pancreas.

surrounding tissues is also a common result. In 255 autopsies in gall-stone cases given by Courvoisier, atrophy of the gall-bladder was found in 12 $\frac{1}{2}$ per cent. It is the result of frequent catarrhal inflammation. In such cases the gall-stones are found imbedded in the contracted gall-bladder or in diverticula.

The obliteration of the cystic canal, the gall-bladder being aseptic, results in atrophy of the reservoir, the same as if it contained foreign bodies more or less irritating. Arménis (Thèse de Paris, '96).

paratively rare, the connective tissue of the liver is increased, and a calculous biliary cirrhosis results. It is very difficult, in many of these cases of cirrhosis, to exclude the possibility of their being caused by other toxins; alcohol, for instance.

[For the notes of the following case I am indebted to Dr. Dwyer. W. B., aged 65, was taken ill with symptoms of biliary obstruction about two years and a half previous to death. Had pain, jaundice, delirium, and anorexia during this



A, Distended gall-bladder; B, junction of cystic and hepatic ducts; C, cup-shaped depression in surface of duodenum at the entrance of the common bile-duct in which the gall-stone was lodged. (Dwyer.)

A calculus in the common bile-duct will, after awhile, produce distension and thickening of the wall of the duct. It sometimes floats in a cavity, often in the ampulla of Vater, acting as a ball-valve, thus causing intermittent or remittent jaundice.

The enlargement of the bile-ducts may extend backward to the smaller radicals. The hepatic cells become deeply stained with bile. In some cases, which are com-

attack from which he recovered in two weeks.

A year or so afterward he had another attack somewhat similar, but symptoms were not so severe. He recovered partially and was discharged in about five weeks. Shortly afterward the patient began to have chills and became cachectic. Chills became more frequent and severe about two months before death, though there was little or no jaundice up till a few days before the end.

Diagnosis of passage of gall-stone was made at first attack, and at a second attack ulceration of stone into duodenum with development of suppurative cholangitis. (See illustrations. The colored plate shows the normal gall-bladder, but turned upward to correspond with the position shown in the half-tone cut, on page 123.) He had, throughout the last attack, irregular rises of temperature. J. E. GRAHAM.]

Treatment.—**PREVENTIVE.**—The partial or complete stagnation of bile in the gall-bladder and ducts is the principal, if not the only, predisposing cause of the formation of calculi. Any means, therefore, which will increase the watery constituent of the bile and render the flow more rapid will be of value as a prophylactic agent. Means whereby the circulation is stimulated will also be of service. The emptying of the gall-bladder and ducts may be brought about by exercise and by internal medication. Horseback and bicycle-riding are to be especially recommended, as well as tennis and lawn bowls and so forth. The occasional administration of calomel followed by a saline cathartic is one of the most effectual methods of emptying the gall-bladder. The taking of large quantities of water, especially of Carlsbad or other alkaline water, an hour or so before meals is of service, as the liver is, in that way, flushed out, and the bile flows more freely.

Ox-bile used internally in biliary colic. The bile is decolorized to get rid of the toxic coloring matter (especially bilirubin), and then sterilized at 220° to 222° F.; 3 ounces of bile produce 2½ drachms of the extract. Of this latter 3 grains in pill or capsules are given twice a day after meals. They may be continued for years, or given intermittently, whenever there is any sign of colic. Results obtained in several cases have been brilliant. It cannot, however, be regarded as a certain preventive of colic, since if the gall-bladder is full of stones it does

not cause them to disappear, though it prevents the formation of fresh calculi. The treatment is recommended after operations for the evacuation of calculi to prevent relapses. Gautier (Rev. Méd. de la Suisse Rom., June 20, '98).

On the question of diet there is much difference of opinion. It is, however, safe to say that starchy and saccharin foods, which render the bile more dense, are to be avoided.

MEDICAL TREATMENT.—Some writers, particularly those who do gall-stone surgery, consider remedial measures of a medicinal character altogether futile. It is quite certain that valuable time should not be taken up after the failure of drugs if jaundice and fever are present, as the patient may soon be beyond surgical help. The administration of alkaline waters, especially of Carlsbad salts, has been, in many cases, followed by good results.

Naunyn (quoted by Krauss) says: "I have not the slightest doubt but that the Carlsbad cures have the best influence on the course of cholelithiasis. I have seen a considerable number of dangerous gall-stone incarcerations, which have lasted a long time, terminate favorably." Krauss states that the cures can be taken at home and should last from four to six weeks. A bottle of Carlsbad should be taken each day as follows: Two tumblerfuls in the morning before breakfast warmed to 140° or 150°, at an interval of fifteen minutes. In the evening one tumblerful should be taken cold. If the water does not produce a free evacuation of the bowels, Sprüdel salt should be given in addition. Krauss attaches great importance to diet. As a rule, he forbids: fat, vinegar, hot spices, pastry; vegetables, both dried and unboiled; roasted potatoes, and cheese. He recommends the following diet in ordinary cases:—

Breakfast: A cup of tea or coffee, little milk; little sugar, if any; and two or three pieces of rusk or toast, one or two soft-boiled eggs, or some fish or cold meat.

Midday meal: Fish (salmon and eels excepted), roasted meat without sauce, green boiled vegetables or mashed potatoes, stewed fruits without sugar. Drink plain or slightly-effervescing water, red wine (one or two glasses), or weak whisky.

Supper: Cold or hot meat (fresh roasted), tea, wine, or whisky (small quantities). He usually limits the bread to from four to six ounces a day.

The use of olive-oil has still many advocates.

Olive-oil is useful in gall-stone, if properly administered. Not more than 1 to 2 ounces may be given. Its action produces a watery flow from the mucous membranes, and therefore helps to increase the flow of the normal duodenal secretions, namely: the biliary, the pancreatic, and the secretion of Brunner's glands. Quite good results have been reported. Indications for surgical interference are: (1) when there is continued fever not traced to other toxins; (2) complete occlusion of the cystic duct, usually by a single large calculus; (3) in cases of chronic obstructive jaundice from impaction by one or more calculi in the common duct. W. H. Thomson (New York Med. Jour., April 19, 1902).

As a rule, too little water is taken in these cases. Alkaline saline waters stimulate peristalsis and increase the flow of blood to the abdomen, the bile-passages being massaged by the former and the diseased mucous membrane benefiting by the latter. These salines do not dissolve the stones, for such allowed to stand two weeks in a 1-per-cent. solution of sodium salicylate, benzoate, phosphate, sulphate, bicarbonate, or chloride; potassium sulphate, or ammonium chloride suffered no loss of weight. Allowed to stand in olive-oil,

however, a gall-stone lost 68 per cent. of its weight in two days and then disintegrated. The solid matter of a stone becomes viscid in a few hours in a 5-per-cent. solution of animal soap. Large doses of oil probably do not reach the gall-stone directly, but, by producing an increased proportion of fat, fatty acid, and soap in the bile, cause it to have a solvent action on the cholesterin of the stone. For this method of treatment from 2 to 10 ounces of oil should be given daily, and the results are very questionable. Massage of the gall-bladder would, in many instances, be useless or harmful. During a gall-stone attack relief is urgently demanded. A pint of water taken as hot as possible, with hot fomentations over the liver, may give relief, or 1 cubic centimetre (15 minims) of spiritus ætheris in 2 teaspoonfuls of chloroform-water every quarter of an hour. Exalgin, 0.06 gramme (1 grain), every half-hour for three or four doses is also of service. These failing, morphine must be used. Mayo Robson (Allbutt's "System of Medicine"; Medical News, March 29, 1902).

In cases of cholecystotomy, when there is an external biliary fistula and gall-stones still remain in the common choledoch-duct, the injection of olive-oil into the gall-bladder has been recommended so as to enable it to directly exert its solvent action on the calculi still remaining. A case is reported by Morris in which a cure by this means took place after six weeks' treatment.

Calomel, followed by salines, may be of use in emptying the gall-bladder and expelling the calculi if they are very small.

Butter recommended to be taken in large quantities instead of olive-oil for the prevention and cure of gall-stones. Fifteen to 20 grammes (4 to 6 drachms) of butter spread on biscuits are to be given each morning. Felix von Oefele ("Artzliche Rundschau," '96-'97).

Enemata of olive-oil recommended for the treatment of cholelithiasis. A more direct action on the liver is obtained by

this mode of administration, while there is less danger of affecting the stomach. This is an addition to our present means of treatment of cholelithiasis. Blume ("Verhandlungen der Congress f. innere Med.," Wiesbaden, '97).

The most effective remedy for biliary colic is an hypodermic of $\frac{1}{4}$ or $\frac{1}{3}$ grain of morphine with $\frac{1}{120}$ grain of atropine. Hot applications applied locally afford some relief, and a weak, hot solution of bicarbonate of soda taken into the stomach in large quantities has been recommended.

Olive-oil in from 5- to 10-ounce doses is said to shorten an attack. Glycerin is also credited with value when employed in the same manner.

SURGICAL TREATMENT.—Much has been accomplished within the last few years in the improvement of older methods and in the introduction of new plans of operation on the more difficult cases of gall-stone surgery.

Cases have, from time to time, been reported in which a diagnosis of cholelithiasis had been made, and when operated upon gall-stones have not been found. In some of these recovery has taken place in a remarkable way.

The arguments in favor of removing gall-stones at the earliest favorable moment after the diagnosis has been made may be summed up as follows: The operation is, as a rule, easy and safe and all stones are quickly removed. The remote dangers of gall-stones are either avoided or lessened. These are: serious disabilities, grave emergencies, and malignant disease. If the diagnosis of gall-stones proves to be wrong, other lesions may be discovered and remedied: lesions perhaps more serious than those of gall-stones. Late operations upon gall-stones are, as a rule, difficult and dangerous. Operations made imperative by progressive and lethal symptoms must be performed under great disadvantages and dangers; the gall-stones are generally more inaccessible, the dis-

sections deeper, and the patient's power of resistance lessened. The arguments against early operation are: There is some danger in the operation, though it is but slight. The diagnosis may be wrong and the exploration unnecessary. There is the possibility of hernia in the scar. There is the possibility that the gall-stones may recur. There is the possibility of spontaneous cure. There is also the possibility that, after offending enough to prove the diagnosis, the gall-stones may give no further trouble. The last and decisive attacks of biliary colic may have been caused by the last remaining gall-stone, exploration showing that none of them remains. M. H. Richardson (Boston Med. and Surg. Jour., Sept. 5, 1901).

In 720 operations the mortality was 15.5 per cent. From these operations, however, 185 can be deducted, either on account of operations at the same time on the stomach or intestines, the pancreas, the liver, etc., or because there was inoperable carcinoma of the gall-bladder, gall-duct, or liver, or diffuse purulent nephritis, peritonitis, or cystitis. This leaves 535 operations solely for gall-stones, with a mortality of 3.5 per cent. It must be remembered in these statistics that all patients who died within one hundred days of the operation are included. Death in many of these cases cannot be ascribed in any way to the surgeon's intervention. In the case of sepsis and carcinoma with a mortality of 97 per cent. the operation is justified because such patients are certain to die, and if 3 per cent. are saved it is a considerable gain. Moreover, error in diagnosis sometimes occurs, and it is found at the operation that the condition is not so severe as was suspected. H. Kehr (Münchener med. Wochen., Oct. 28, 1902).

Henry Morris (in Krauss, on "Gall-stones") states that there are several cases on record to prove that, where pain alone or pain with jaundice has been such as to reduce patients to the verge of suicide or death, laparotomy and digital examination of the liver and gall-

ducts have restored the sufferer to complete good health, though no tumor nor gall-stones have been found to account for the symptoms. Morris found adhesions to the abdominal wall in one case, and in another a general enlargement of biliary ducts from some unknown cause. It is possible that in some of these cases a gall-stone in the ampulla of Vater may be pushed through into the duodenum during the manipulation.

The indications for operation in cholelithiasis are thus given by Mayo Robson: "1. In frequently-recurring biliary colic without jaundice with or without enlargement of the gall-bladder. 2. In enlargement of the gall-bladder without jaundice, even unaccompanied by great pain. 3. In persistent jaundice ushered in by pain, and where recurring pains with or without ague-like paroxysms render it probable that the cause is gall-stones in the common bile-ducts. 4. In empyema of the gall-bladder. 5. In peritonitis starting in the right hypochondriac region. 6. In abscesses around the gall-bladder or bile-ducts whether in, under, or over the liver. 7. In some cases, where, although the gall-stones may have passed, adhesions remain and prove a source of pain and illness. 8. In fistulæ: mucous, muco-purulent, or biliary. 9. In certain cases of jaundice with distended gall-bladder dependent on some obstruction in the common bile-duct. 10. In phlegmonous cholecystitis and in gangrene, if this can be seen and recognized at a sufficiently-early stage of the disease." (Allbutt's "System of Medicine.") Robson does not approve of sounding for gall-stones through the abdominal walls. He also condemns massage of the gall-bladder.

Among the cases of gall-stones not to be operated upon are those where the first paroxysm of pain is succeeded by

all the typical manifestations, where the patient becomes jaundiced on the second to third day and passes small stones by the natural way. Repeated attacks are not indications for operations when each time small stones are passed. When there are numerous attacks without the passage of small stones then the question of operation arises on account of the suspicion that, besides the small calculi, there may also be large ones impacted in the gall-bladder. Those cases should not be operated upon in which after repeated ineffectual attacks larger calculi have been passed, for if a large stone has been passed others may follow. If ineffectual attacks continue to follow, an operation is indicated. But a single ineffectual attack, without jaundice, indicates operation. A state of latency may be partially at times brought about by aperients, but it is of short duration. Operation is indicated in those cases where, after repeated ineffectual attacks, the uppermost stone enters and becomes impacted in the ductus choledochus. This impaction must be determined by waiting, two to three weeks being sufficient. Riedel (Berliner klin, Woch., Jan. 21, 1901).

In one-third of the cases the symptoms were of ten years' or more duration. In less than one-fourth the symptoms had persisted for less than two years. Cholecystenterostomy is a makeshift at the best; the cystic duct may not be patent. Expression of the stone into the duodenum or bladder is not easy. No cases have been operated upon by the transduodenal route. Crushing of the stone leaves *débris*. In none of the above methods can it be determined whether or not the ducts are patulous. In six of the cases only one stone was found. For the relief of the late desperate cases a rapid cholecystotomy may be made. The method of choice consists in incising the duct, removing the stone, suturing the duct, and draining the gall-bladder. This procedure was carried out in 21 of the cases without a death. M. B. Tinker (Phila. Med. Jour., June 21, 1902).

As soon as gall-stones give serious

trouble, operation is indicated, for it is only from the complications which in many cases arise sooner or later that any danger after operation need be apprehended. Medical treatment may do much to relieve the catarrh associated with cholelithiasis, but no medicine can dissolve gall-stones or produce permanent relief. It is impossible to say what operation will have to be done until the abdomen is opened and the exact state of affairs made out.

No surgeon should attempt the removal of gall-stones unless he is prepared to perform any of the various operations on the biliary passages, and no operation should be concluded until it is determined that the ducts, including the hepatic and common, are free from concretions, otherwise dissatisfaction is certain to follow. A gall-stone scoop is the only special appliance that need be employed. Rubber gloves impair the sense of touch and cause delay. In jaundiced patients calcium chloride is given in 30-grain (2 grammes) doses by mouth before operation and afterward in 60-grain (4 grammes) doses by rectum, thrice daily for two or three days or longer if necessary.

A sandbag, placed under the patient at the level of the liver, will push the spine forward and with it the liver and bile-ducts; so that the common and hepatic ducts are brought several inches nearer the surface. The writer always makes his incisions over the middle of the right rectus and in line parallel with its fibres, which are separated by the finger. If more room is required, the incision is carried upward in the interval between the ensiform cartilage and the right costal margin as high as possible. By lifting the lower border of the liver, first drawing the organ downward from under the cover of the ribs, the whole of the gall-bladder and the cystic and common ducts are brought to the surface. An assistant gently draws the gall-bladder upward with one hand and retracts the left side of the wound and the viscera with the other. The gall-bladder, cystic and common ducts now form a straight passage from the fundus of the gall-bladder to the

duodenum, and the whole length of the ducts, with the duodenum and head of the pancreas, are in view. Stones in the ducts are detected by palpation and removed by incision into the ducts. If the common duct has been incised, a probe may be passed into the hepatic duct and down the common duct into the duodenum. The incision into a bile-duct is closed by a curved needle held in the fingers without a needle-holder, a continuous catgut suture being used for the margin of the duct proper, and a continuous catgut or celluloid thread being employed to close the peritoneal edges of the duct. When the gall-bladder is contracted and a swollen pancreas presses on the common duct, a drainage tube is inserted into the hepatic duct, passing upward through the common duct, and here held by a catgut stitch. Prolonged manipulations are never made on a stone deeply impacted even in the cystic duct, but the duct is at once incised and the concretion removed. Drainage is effected by gauze surrounded with a split drainage tube, which is brought out by the side of the gall-bladder drain. All bleeding points and all firm adhesions are ligated. Ideal cholecystotomy (cholecystotomy in two stages) and partial cholecystectomy (Mayo) are not regarded with favor. A contracted gall-bladder which cannot be brought to the surface may be drained by fixing a tube into it with a purse-string suture, the general peritoneal cavity being protected by gauze packing. In many of these cases it is better to remove the gall-bladder. If a stone is impacted in the duodenal ends, a duodeno-choledochotomy is sometimes the easiest operation. A cholecystenterostomy is rarely used because the trouble is not removed; when it is necessary it will be found easier to anastomose the gall-bladder with the colon. In detaching adhesions a careful search must always be made for an opening into the hollow viscera. A. W. Mayo Robson (British Medical Journal, Jan. 24, 1903).

Cholecystotomy is the operation of choice in cholelithiasis, and it is consid-

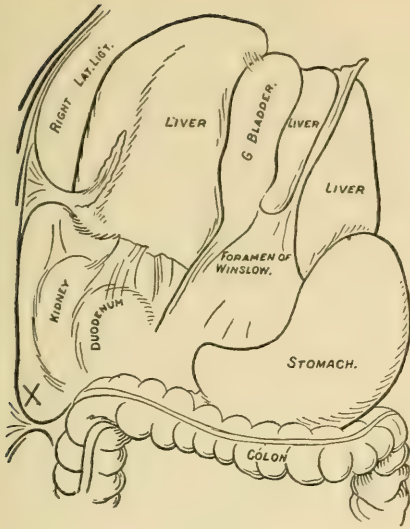


Fig. 1.—The pouch described shown by drawing liver upward. X in all the figures marks point for drainage.

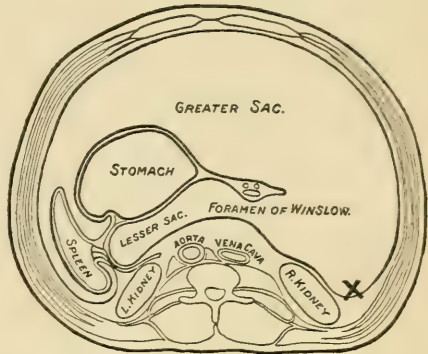


Fig. 3.—Transverse section through centre of pouch.

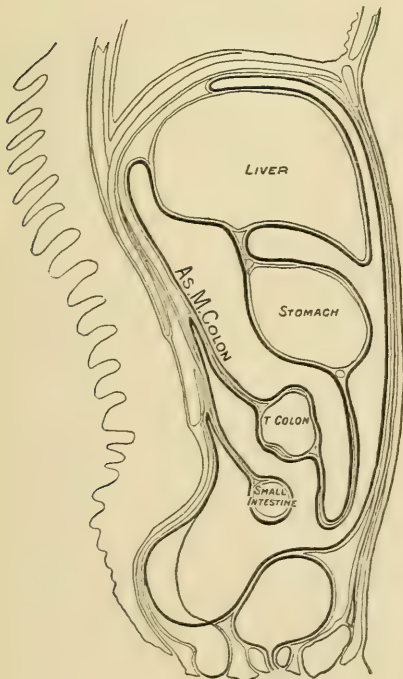


Fig. 2.—Vertical mesial section.

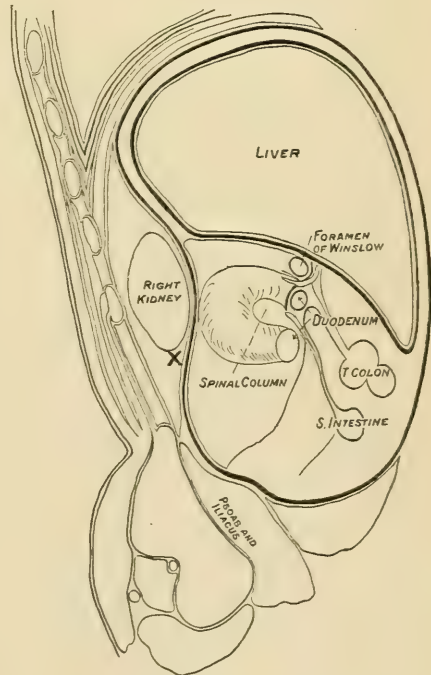


Fig. 4.—Pouch (X) behind the right lobe of the liver having natural barricades from the general peritoneal cavity.

Posterior hepatic pouch. (Morison.)

(British Medical Journal.)

ered safer, after opening the gall-bladder, removing the calculi, and ascertaining that the biliary passages are clear, to suture the walls of the gall-bladder to the edges of the wound than to perform the so-called "ideal" operation of suturing the opening in the gall-bladder and returning it into the abdomen. It is better to suture to the aponeurotic layer of the abdominal wall and not to the skin. Mayo Robson prefers, when there is time, to stitch the peritoneal layer of the gall-bladder to the parietal peritoneum and the mucous layer to the aponeurosis. A drainage-tube is then inserted.

When a fistulous opening is left, calculi not removed at the operation may find an exit. When the incised gall-bladder is returned to the abdominal cavity leakage may take place.

When the gall-bladder is contracted and cannot be brought to the edge of the wound, Mayo Robson sometimes tucks down the parietal peritoneum to the gall-bladder and sutures it to the edge of the incision. When he cannot do this, he utilizes the right border of the omentum by suturing it to the gall-bladder opening and to the parietal peritoneum around the drainage-tube and shutting out the general peritoneal cavity. If neither of these methods can be adopted, he passes a drainage-tube through the opening into the gall-bladder and plastic peritonitis shuts off the general peritoneal cavity. The tube is sometimes packed around with gauze. He prefers to drain the peritoneal cavity by passing a tube into the right kidney-pouch through the original abdominal incision or through an opening in the side of the abdomen.

A fistula does not close because the mucous membrane is sewed to the skin, but it does close when united to the cut

edges of the peritoneum and transversalis fascia. Perkins (Boston Med. and Surg. Jour., Jan. 25, '94).

In cases of obstruction of the common duct, no attempt should be made to suture the opening after the obstruction has been removed, as the patient's condition is nearly always serious and a prolonged operation would terminate fatally. The obstruction should always be removed, if possible. Experiments demonstrating that the peritoneum is capable of bearing the presence of a small amount of bile, but that large quantities or the constant extravasation of it would produce a fatal peritonitis, usually in from twenty-four to forty-eight hours. W. E. B. Davis (N. Y. Med. Jour., Oct. 26, '95).

Case of biliary obstruction complicated by peritoneal adhesions. A first incision was made in a line of and down to a distended gall-bladder. A second incision was made in the right flank and about a pint of foetid and bile-stained pus was evacuated. The abscess-cavity was bounded above by the liver, behind by the colon, the distended gall-bladder on inner and parietal peritoneum on the outer side. Ten ounces of healthy bile and forty-three gall-stones were removed from the distended gall-bladder. W. F. Brook (British Medical Journal, Feb. 5, '98).

As results of 27 operations on cases of gall-stones, the following conclusions are reached: 1. Tait's operation of simple cholecystotomy with drainage of the gall-bladder is the ideal operation in most cases. 2. Incision of the common and cystic ducts is the safest and most surgical means of removing stones in them. 3. Excision of the gall-bladder may find a wider field than heretofore. 4. McBurney has shown that incision of the duodenum, and either dilatation or incision of the common duct through this incision, is, in skilled hands, both efficient and safe for the removal of stones low down in the common duct. In neglected cases with dense and many adhesions and dilated stomach, an additional gastro-enterostomy or pyloroplasty will save cases which would otherwise die. 5. The mortality of the simple cases is prac-

tically *nil*. W. W. Seymour (Amer. Jour. of Obstet., Nov., '99).

Choledochotomy.—Much attention has been given within the last three or four years to the improvement of this operation, and, although in many cases difficult, it can be performed with greater safety to the patient than formerly. The suturing of the incised walls can be much more easily and completely done, and leakage to a very great extent prevented.

An exploratory operation is indicated when biliary retention has persisted for three months without amelioration. Such an operation is not always easy; when there are adhesions the relations are changed and the gall-bladder is not readily found. By following the course of the umbilical vein the ductus choledochus will be found on a plane oblique to it. If its relations are normal the liver can be elevated and the left index finger introduced into the foramen of Winslow, which is drawn down, while the right index finger follows the left border of the gastro-hepatic omentum. When a calculus is present it is better to perform choledochotomy, when simple pressure of the finger is not enough to cause the stone to pass into the duodenum. The higher up the calculus—that is, the nearer the liver—the more difficult is exploration, incision of the canal, and suture.

In such cases the duct may be left open, as the fistula will heal spontaneously, but drainage must be established in order to isolate the area from the remainder of the abdominal cavity. Quénu (Le Bull. Méd., May 12, '95).

With our present experience and technique we may safely say that choledochotomy, in the majority of cases, is a difficult and tedious operation which may tax to the utmost the resources of the patient, but its results usually are eminently favorable. Jaundice should not be allowed to exist too long. Let me emphasize once more that preservation of life and health in many cases depends upon the proper time being chosen for

surgical interference. Lange (Med. News, May, '97).

In many instances biliary calculi may be removed from the common bile-duct through an incision in the anterior wall of the descending duodenum. This is an exceptionally good route, if the calculus be situated in the lower third of the common duct. The orifice of the duct may, if necessary, be incised for one-half inch, with perfect safety, and the duct itself is easily dilated. Method employed on six different occasions, and in each instance the intestinal wound healed kindly. Charles McBurney (Annals of Surg., Oct., '98).

One of two incisions should be employed in exploring the region of the gall-bladder or bile-ducts; the best one extends from about $\frac{1}{2}$ inch below the free border of the costal cartilages to a point 2 or 3 inches above the umbilicus, passing just within the outer border of the rectus muscle. The second is a curved incision parallel with the free border of the costal cartilages and about 1 inch below them.

None but the ninth dorsal nerve will have been divided by either of the two incisions as described. The longitudinal one is to be preferred. If the gall-stone be lodged in the gall-bladder the calculi are removed from an incision in the fundus of the gall-bladder after the latter has been stitched to the abdominal wall. In order to avoid annoyance of a fistula's persisting for weeks or months after operation, McBurney recommends following modification of ordinary procedure: The circumference of gall-bladder about one-half inch below fundus is sutured to the edges of abdominal wound; a purse-string suture is passed around gall-bladder between opening in fundus and line of suture to abdominal wall; the free edge of incised fundus is now inverted, a small rubber drainage-tube is inserted, and the purse-string is tightened, so as to prevent reversion of inverted edges. After this method the drainage-tube may be removed in the course of several days and in a short while the fistula will be permanently closed. C. McBurney and H. D. Collins (Med. News, Nov. 26, '98).

Dr. W. S. Halsted, in an article in

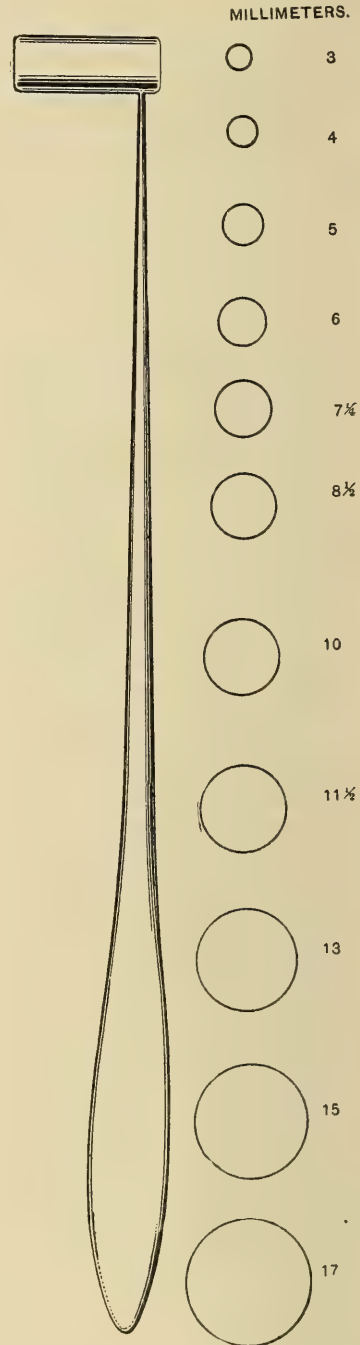
Johns Hopkins Hospital Bulletin, April, 1898, on the use of small hammers and the suture of the bile-ducts, commences as follows: "The surgery of common bile-ducts is still in its infancy. 'Suture of the thickened duct is difficult enough and suture of the normal duct is out of the question,' says one. 'It is not worth while to exercise great care in sewing up a slit in the common bile-duct, for it is almost impossible to prevent leakage, and a little additional leakage can do no harm if one drains,' says another. 'Wait until the common duct dilates and thickens before venturing to open it,' say all surgeons."

Halsted states that he has ascertained from operations on dogs and man that the normal bile-ducts can be sutured easily, accurately, almost infallibly, and without danger of leakage or constriction. He approves of Lange's suggestion to cut through one or two ribs and the diaphragm, if it is necessary thus to render the parts operated upon more accessible. He then describes small hammers, the heads of which, being of various sizes, he inserts into the common duct, after the incision has been made and the stone removed. The contents are thus prevented from escaping, and the duct can be raised or lowered at will by the operator. The wall is more easily sutured over the head of the hammer. He has a series of hammers which he attaches to a long handle, using one of proper size to easily enter the duct. The method is graphically shown in the annexed colored plate, while the hammer and the various diameters of the latter employed are illustrated here.

Series of 209 laparotomies for gallstones with special reference to 30 cases of choledochotomy. He classifies his operations into five groups:—

1. Those in which the stone is found in the gall-bladder or cystic duct; 97

one-sided and 3 double-sided cholecystotomies, 4 cystendysis and 23 cystecto-



Hammers employed in suturing the gall-bladder. (*Halsted.*)

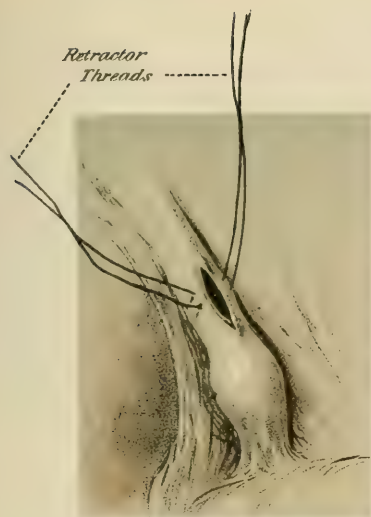


Fig. 1. Gall Bladder

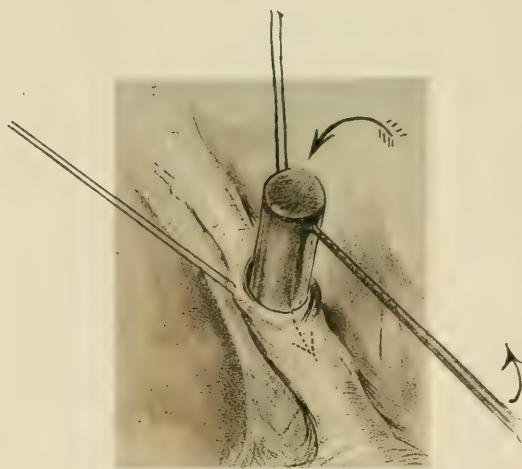
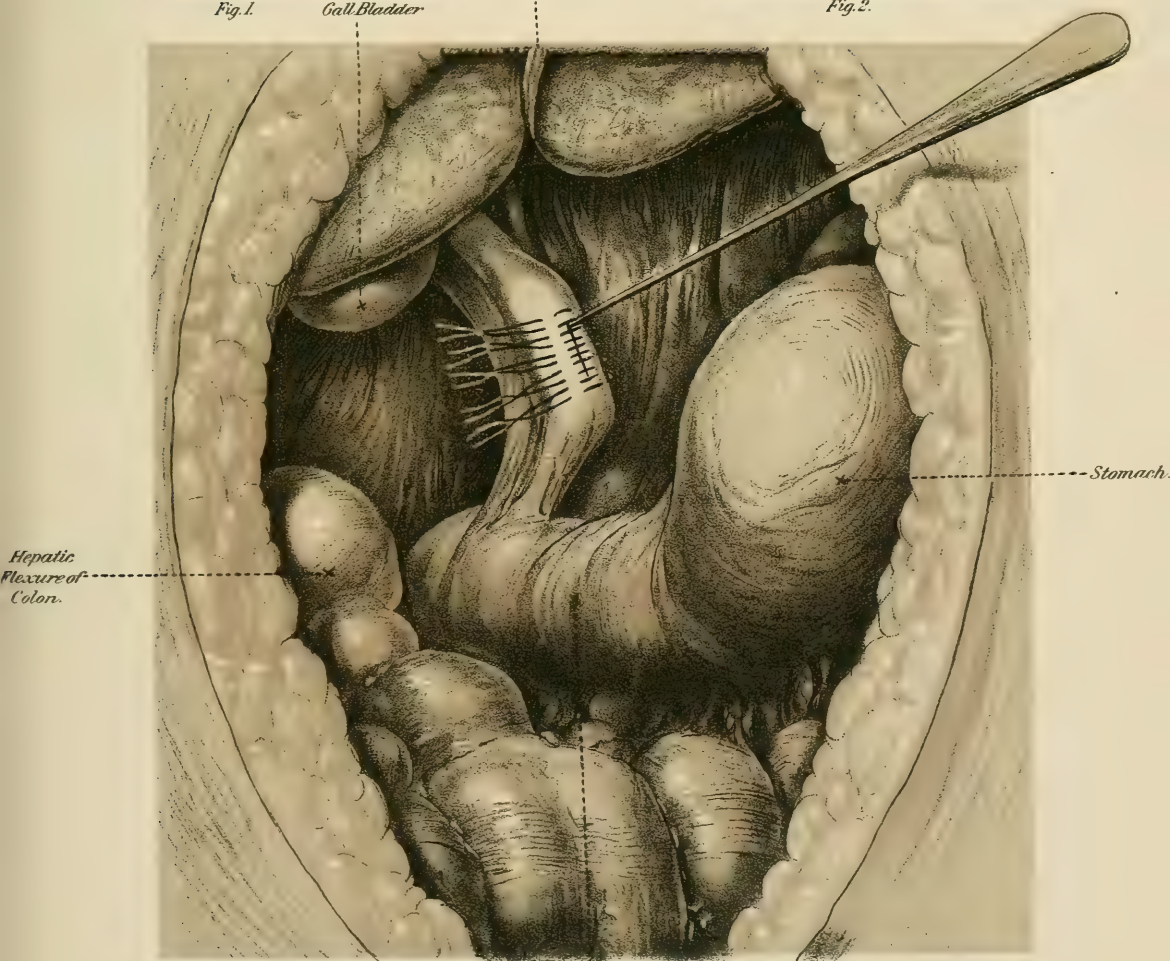


Fig. 2.



Pylorus
Fig. 3.

Suture of the Bile Ducts. (Halsted.)

mies. Altogether 127 gall-bladder operations with but 1 death.

2. Two cystectomies and 1 death.

3. Stone in choledoch-duct which could not be moved into the gall-bladder or duodenum; 30 choledochotomies, 2 deaths.

4. Seventeen cases with dense adhesions, fistula, etc.

5. Cases complicated by carcinoma and other conditions necessarily fatal in the end.

The mortality bore a definite relationship to the pathological conditions present. In the 209 laparotomies there were 17 deaths, being 8 per cent.; but the mortality was reduced to a minimum in the case of stones on the gall-bladder and cystic ducts, while it reached 6 per cent. when there were changes in the gall-bladder which demanded cholecystectomy. Suppurative cholangitis proved a very fatal condition. Emphasis laid upon the following three points, viz.: accuracy in the diagnosis of gall-stones, a thorough knowledge of the pathology of the disease, and perfection in the technique of the operation. Hans Kehr ("Verhandlungen der deut. Gesellschaft f. Chir.," xxv Congress, '96).

Cases of cholelithiasis treated in the St. Hedwig Hospital at Berlin during ten years analyzed. Of these cases 89 were treated in the medical and 43 in the surgical wards. Fifty-seven of the medically treated were traced and it was found that, after from 1 to 2 years, 13 patients still suffered; after from 3 to 4 years, 5; and after from 5 to 8 years, 5. Twenty-two, or 41.5 per cent., were cured, 4 had to be operated upon subsequently, and 4 died. The results of surgical treatment showed the mortality 12.5 per cent.; but when the cases in which death was due to causes independent of the operation were deducted, the remaining mortality was only 2 per cent. In none of the cases was there a return of stone-formation or of colic. Two cases suffered from cramps which were probably connected with disturbance in the celiac ganglia and the abdominal sympathetic. H. Scheuer (Münchener med. Woch., June 12, 1900).

Morris mentions a case in which, after opening the gall-bladder and removing

calculi, stones were found in the common duct which could not be removed. During the convalescence olive-oil was daily injected through the fistulous opening. In six or eight weeks the passage became patent and the patient made a good recovery.

Choledocolithectomy is the proper operation for stones in the common duct except in very rare cases, such as those in which the adhesions are so dense that it is impossible to isolate the ducts. In some cases the ducts above an obstruction will be found enormously distended and the walls unhealthy and friable. J. F. W. Ross (Inter. Clinics, Jan., '98).

[Result of anastomosis of the gall-bladder with the colon. J. F. W. Ross reports a case operated on in February, 1896, as still in excellent health. The patient was suffering from a gall-stone impacted in the common bile-duct, producing intense jaundice. At the time of the operation the adhesions were so great that it was impossible to isolate the common duct. The liver was torn in an attempt to accomplish this. As a consequence, an anastomosis was produced between the gall-bladder and the colon by means of a small Murphy button. The button was passed about the sixteenth or seventeenth day after operation. The jaundice rapidly disappeared and the patient soon regained his health. He was seen a month ago in perfect health. The fact that the bile was side-tracked into the colon had no visible ill effect.

Ross also reports having found gall-stones lying in the common and hepatic duct, one beside the other like a row of cobble-stones. The stones in the hepatic duct were found far up to the end of the duct. They were removed by a milking process. In the first place, a silk suture was placed like a running string on the wall of the duct. This was put in position before the duct was incised, so that by pulling on it like a purse-string the orifice could be readily closed and the bile kept from welling into the field of the operation. If the duct is incised first, the bile welling out through the orifice obscures the view. He has adopted this

method of procedure on several occasions, and finds it of great service.

After the suture was placed he then made an incision into the common duct inside the oval formed by the suture. With the index finger of the left hand on one side of the duct and the index finger of the right hand on the other side, the stones were gradually squeezed down from the hepatic duct and up from the intestinal end of the common duct to the opening just made and pressed out through it. In this way ten or twelve stones were removed. As the gall-bladder had been previously opened and three stones removed from the interior of the gall-bladder, it was deemed advisable to stitch the gall-bladder to the abdominal wall and place a drainage-tube in its interior. The patient made an uninterrupted recovery and has since enjoyed excellent health. J. E. GRAHAM.]

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Toronto.

CHOLERA ASIATICA.

Definition.—Cholera Asiatica is a miasmatic, contagious disease transmitted mainly by human intercourse, but whose epidemic character depends upon outside conditions.

Origin and Transmission.—The original seat of cholera is in India, where it most probably existed long before this century. In some parts, especially on the borders of the Ganges it is always endemic, being produced and entertained by special conditions of the soil, by the infection of the water, etc., and often giving rise to epidemic outbreaks under the influence of high temperature, climatic variations, bad hygienic conditions, certain winds, etc. The epidemics may propagate themselves either by land or by sea, through the great roads of commerce, being conveyed to other countries by caravans or by vessels, forming here and there many momentary, secondary centres. The agents of trans-

mission are persons infected with cholera or specific diarrhoea, and the linen, clothes, etc., soiled with choleraic dejections, from such persons.

The land-route was followed by the first great epidemic of 1830 and 1848 (the last reaching America), while the second prevailed in the epidemic of 1869 and of 1884. When the cholera proceeded by land, its course was slow and its steps easily marked, by its invading successively Afghanistan, Persia, the Caspian shores, Astrakan, Russia, and then turning toward the west of Europe and America. The epidemics transmitted by sea generally made their first appearance at Mecca or other parts of the Red Sea, and thence were propagated to Egypt, or reached Beyrouth, Constantinople, Marseilles, Toulon, Naples, etc., each of these places becoming a new starting-point for the infection.

Countries spared by this scourge are exactly those places out of such commercial roads, as are the islands of the north of Europe, Faroe, Hebrides, Iceland and Greenland, Baffin and Hudson Bays, Patagonia, western America, Polynesia, Australia, central Africa, etc.

For several epidemics—those of 1852 and of 1859 in Europe afforded a striking example, for instance—a direct transmission of cholera from India could not be traced; so that they must be attributed to a local revival of the cholera germ, with all its primitive attributes, in places where it had previously been carried from India. It seems, therefore, that cholera germs of former epidemics may live as saprophytes and wait until conditions arise, when they again become virulent.

The germs of cholera, when brought into some places, there to give rise to an epidemic of cholera, must find local conditions favorable to their development.

Low, damp, marshy lands, large towns with crowded populations, narrow, dirty streets and generally every place in which the sanitary conditions are very imperfect and the inhabitants very poor are always the first and main centres of the disease.

Decaying vegetable and animal matter, bad drainage, and overcrowding are as much responsible for cholera as bad drinking-water. The regular removal of faecal matter and efficient surface- and subsoil- drainage will reduce the chance of introducing cholera into a town to a minimum. Rai B. A. Mitra (*Indian Med. Rec.*, Feb. 15, '93).

Koch's vibrios traced to farm-yard manure, pigs' faeces being found to contain them. Nevertheless there had been no cholera for years in the region. Kutscher (*Zeit. f. Hygiene u. Infectiouskr.*, B. 19, p. 461, '95).

According to Pettenkofer, indeed, the most important part in the development of cholera is played by certain geological conditions of the soil (especially porosity and dampness), and by the variations in the level of the ground-water; so that if such a soil become infected by choleraic germs, finding in it the best conditions for their growth, and, gaining there their virulent properties, the disease diminishes when the ground-water is high, and increases when its level sinks.

Investigations on 78 choleraic patients at the Hôpital Beaujon. In 67 cases the comma bacillus was isolated. During the epidemic the virulence of the micro-organism had diminished, for, in order to kill a guinea-pig, a much larger dose of a culture isolated in September, 1892, was needed than of that isolated in April of the same year. Girode (*Comptes-rendus Hebd. des Séances et Mem. de la Soc. de Biol.*, Oct., '92).

Study of 251 cases of cholera, in no one of which was the spirillum found, but always mixed with one or more bacteria of other kinds. Lesage and Macaigne (*Ann. de l'Inst. Pasteur*, Jan., '93).

Even by the various methods recommended by Koch for the recognition of the cholera bacillus, and, with the greatest care and the most accurate knowledge of the subject, it is often impossible to come to a positive result. The cause of the disease is not the common bacillus, but some unknown noxious principle. O. Liebreich (*Berl. klin. Woch.*, No. 28, '93).

Personal experiments carried out with a view to determine the specificity of the choleraic bacillus. A sufficient quantity of the micro-organism swallowed to give rise to the disease, and practically negative results obtained. This invalidates the principle of specificity ascribed to the pathogenic microbe, and tends to prove that it is not constantly virulent and able invariably to give rise to cholera. (Pettenkofer and Emmerich.)

Pettenkofer's experiment repeated without injury. At first the experimenters took only small amounts of choleraic cultures without result, then they took larger amounts, and one of them ate an entire culture of a third generation. In this case in thirty-six hours came pain in the bowels, tenesmus, and diarrhoea without particular characteristics. In one other experiment, in which not a sign of sickness occurred, the cholera bacillus was found in the normal dejections. Hasterlik (*Corres. f. Schweizer Aerzte*, Apr. 1, '93).

Such experiments prove nothing. Everyone who has lived through an epidemic of cholera knows that there always are a large number of slight cases. Such mild cases are really cholera, as it can be shown that the dejections contain large quantities of comma bacilli. Guttman (*Med. Press and Circular*, Jan. 25, '93).

While accepting the comma bacillus as the etiological factor of Asiatic cholera, its presence in the intestine necessarily leads to the development of cholera or a cholera-like disease. The presence of comma bacilli in apparently healthy persons suggests that the bacilli may temporarily or permanently lose their virulence. Rumpf (*Centralb. f. klin. Med.*, No. 25, p. 2, '93).

Lesions of cholera produced by giving intravenous injections of cholera bacilli,

pure cultures being obtained from the fæces. If the animal received doses of absolute alcohol for two days before the injections, the predisposition to the cholera infection was very greatly increased. Thomas (*Archiv f. exper. Path. u. Pharm.*, vol. xxii, No. 1, '94).

Experiments showing that the activity of the bacilli in the case of men is not parallel to their virulence in animals. The course of epidemics cannot be attributed alone to the biological characteristics of comma bacilli. It is very probable that the symbiosis of the comma bacilli with other species of micro-organisms found in the dejections and in the intestines of cholera patients plays an important rôle. Blachstein (*St. Petersburger med. Woch.*, Jan. 27, '94).

Study of 293 cases of cholera in Arabia; the comma bacilli found in 280. Also discovered bacilli in his own stools without having any of the symptoms of cholera. Immunity is possibly the result of an attack of cholera experienced in 1892. Karlinski (*Centralb. f. Bakt. u. Parasitenk.*, May 19, '94).

Very severe and even rapidly fatal cases of cholera occur with all the characteristic symptoms of the disease, yet careful examination fails to show bacilli in the stools; and that, on the other hand, cases which are clinically identical with mild diarrhœa may yet have abundant bacilli in the discharges. Radecki (*St. Petersburger med. Woch.*, Feb. 17, '94).

It is not sufficient in explaining typhoid and cholera epidemics to demonstrate the presence of the typhoid and cholera bacilli in the water (X), but that there is another factor: a local one connected with the soil (Pettenkofer's Y). Von Pettenkofer (*Münchener med. Woch.*, May 2, '99).

Of course, a polluted water-supply may aggravate an epidemic of cholera by furnishing a good medium of culture, and a good water-supply may, on the contrary, lessen an epidemic; but the spread of the disease, by means of drinking-water, is not satisfactorily explicable.

State of our knowledge regarding the causation of cholera, as shown by the

epidemic of 1892-93. The history of this epidemic shows that the disease does not spread by means of contaminated rivers, since it extended from large cities rapidly toward the interior, in the direction opposite to the course of the stream. Neither did the contamination of drinking-water satisfactorily account for its spread. The dejecta contain cholera bacilli and the cholera contagium,—viz.: the spores which are produced by the bacilli,—the latter being more tenacious of life than the bacilli, and also more virulent. The disease is spread by articles soiled by dejecta or by the diffusion of the dried pulverized dejecta through the air. Consequently cholera epidemics are most apt to arise in dry seasons. The contagium of cholera always enters the system through the digestive apparatus. These deductions teach us the great importance, from the stand-point of prevention, of bringing all dejecta and objects soiled by them under water as soon as possible. Lachmann (*Deutsche med. Zeit.*, Jan. 4, '94).

Vibrios are present in sewage and Seine water, Paris, and in Versailles drinking-water, when no cholera is present. Sanarelli (*Ann. de l'Inst. Pasteur*, vol. vii, p. 693, '95).

Same observations in the Spree, Oder, and Havel streams and Berlin water-supply. In the latter two the vibrio was found pathogenic and gave cholera-red reaction. The Massowah vibrio and phosphorescent vibrios from Hamburg are probably the true cholera vibrios. Pfeiffer (*Zeit. f. Hygiene u. Infectiönskr.*, B. 1, p. 759, '95).

There are 150 varieties of vibrios differing greatly from Koch's, but growing typical specimens for some time in water. Dunbar (*Deut. med. Woch.*, p. 138, '95).

Evidence showing direct, positive agency of polluted water in the causation and spread of Asiatic cholera. Oetvös (*Le Bull. Méd.*, Jan. 9, '95); Fallot, Cassoute, and Bouissou (*Marseille-méd.*, Oct. 1, '94); Körber (*Zeit. f. Hygiene u. Infectiönskr.*, p. 161, '95); von Heusinger and C. Fränkel (*Berliner klin. Woch.*, Mar. 25, '95); Clemow (*Brit. Med. Jour.*, Oct. 13, '94).

Experiments showing that vibrios may

survive an entire winter and freezing. Kasansky (Centralb. f. Bakt. u. Parasitenk., p. 184, '95).

Vibrios in faecal matter, as a rule, die within the first 20 days, seldom living 30. Vibrios are sometimes present without diarrhoea or other choleraic symptoms, even in formed stools. Rumpel (Berliner klin. Woch., No. 4, '95); Abel and Clausen (Centralb. f. Bact. u. Parasitenk., B. 17, p. 77, '95).

The water of a town containing sewage in which faecal material, urine, etc., is present rapidly destroys the vitality of cholera vibrios, and the danger of a spreading of cholera by canal-water or sewage in which no faecal material or only a very small quantity is present is much greater. Stutzer (Centr. f. Bakt., Parasitenk., etc., p. 200, '98).

Correspondence between cholera and the prevalence of comma bacteria in well-water of Gujerat during the famine of 1900. The results of researches show that none of the comma-shaped bacteria isolated from Gujerat waters could be termed true cholera vibrio. There was, however, a marked resemblance morphologically, biologically, and tinctorially with the true cholera-producing microbe. So marked was this similarity that it is personally believed that the bacteria found belonged to the tribe of curved bacteria, which includes the true cholera-producing microbes. In many of the localities where these comma bacteria were found cases of true cholera were present, which shows an enhanced significance between the incidence of cholera in a locality and the presence of curved comma-shaped microorganisms. G. Lamb (Phila. Med. Jour., from Lancet, Apr. 20, 1901).

But, though Pettenkofer's theory is based upon serious arguments, on the other hand, it is not less demonstrated, according to the views of Koch, that cholera, in a large proportion of cases, is transmitted through drinking-water and several kinds of food, as milk, fresh vegetables, fruits, etc., soiled by the dejecta, showing in the clearest manner possible, that germs, coming from stools

of choleraic patients, are swallowed and find their way to the stomach and to the intestine, whose alkaline juice is necessary for their growth, and in which the entire process of cholera runs its course.

Vibrios are destroyed in fresh milk within twelve hours. Hesse (Deutsche Viertel. f. öffentl. Gesundheits., B. 26, p. 652, '95).

Experiments showing that cholera vibrios live at least thirty-eight hours in milk, and that they develop until the milk coagulates at ordinary temperature. They may even live in coagulated milk. Basenau (Archiv f. Hyg., B. 23, H. 2, '95).

The infection, however, may be still inhaled, coughed up, and afterward swallowed; so that a diffusion of the dried, pulverized stools through the air cannot be excluded. But in every case the contagion of cholera enters the system through the digestive apparatus.

Indeed, we are of the opinion that both theories are in accordance with fact, and that, while direct infection through drinking-water and food is an important factor in the propagation of the disease, on the other hand, the development of epidemics and the preference shown by cholera for certain places can only be explained by certain unsanitary conditions and a peculiar constitution of their soil, especially favorable to the life and growth of the cholera germs. Asiatic cholera must be regarded, therefore, as a contagious and miasmatic disease.

Experiments with flies showing that they are most successful infection-carriers. A fly, which had been infected by being put upon a mass of cholera bacilli, was placed on a piece of beef, which, after a time, was found to contain an enormous number of living bacteria. Uffelman (Lancet, July 15, '93).

Series of experiments showing that not only the comma bacillus, but also other bacteria existing in the intestines of choleraic cadavers, are preserved in the in-

testines of flies at least three days; bacterium thought to be the vibrio Metschnikowi, when removed from the intestines of flies three days after infection, killed a guinea-pig and a pigeon after the same lapse of time (twenty-four hours) as a vibrio received directly from the intestines of a choleraic cadaver. Savtschenko (Wratsch, No. 45, '93).

The danger of infection by the postal service is exceedingly great. A letter infected with cholera bacilli put, as in the ordinary way, into a post-bag was found, after twenty-three hours and a half, to be still covered with living bacilli. On post-cards they were found living twenty hours after infection. On coins the bacilli died with remarkable rapidity, whereas, on woolen and linen stuffs they enjoyed a particularly long life. Uffelman (Lancet, July 15, '93).

It is possible for the cholera spirillum to be taken up in the air in dust, and thus transported. Uffelman (Berliner klin. Woch., June 26, '93).

Account of an outbreak of cholera in Burdwan jail, furnishing strong presumptive evidence in favor of the theory that flies may spread disease. Nine cases of cholera, 4 of which were fatal, occurred in 6 different sleeping wards. Just outside of the jail-walls, at the corner where the ordinary prisoners were fed, were a deserted compound and row of dirty huts, where a year ago had been a number of fatal cases of cholera. Swarms of flies were blown by this wind from the huts into the jail-yard, where, on reaching the trees and corner of the high jail-wall, they obtained shelter from the storm and settled on the food exposed on plates before the gang which fed at this corner. All the affected prisoners were fed at this place on the evening of the storm. Surgeon Captain W. J. Buchanan (Indian Med. Gaz., Mar., '97).

But, whatever its origin may be, the disease does not attack all those who are exposed to it; in fact, during an epidemic we see that it develops mainly in those who are predisposed to it, on account of previous diseases, dietetic errors, mental or physical strains, and other causes disturbing digestion or generally

diminishing the organic resistance of the individual.

The healthy human body does not furnish a congenial ground for the specific bacillus. Out of 39 persons, mostly of the pauper class, who died of cholera, and were examined at the Hospital of St. Peter and St. Paul in 1892, the following results were found as to the presence of other diseases:—

	Cases.	Per cent.
Nephritis chronica interstitialis	35	90
Dilatatio ventriculi..	28	70
Sclerosis cranii.....	18	45
Cirrhosis hepatis.....	16	40
Gastritis glandularis.	15	37
Pleuritis adhesiva....	8	20
Atheroma aortæ et arteriarum cerebri.	7	17
Endocarditis vegetativa	4	10
Pachymeningitis	3	7.5

In 21 women, in whom autopsies were made, abortion was found to have occurred 7 times. Rewowski (Archives des Sci. Biol., p. 517, '92).

Alcohol increases six times the degree of predisposition, in a given individual, to choleraic infection, not only by modifying cellular function and causing vascular troubles, but also by decreasing the bactericidal power of the blood. Thomas (Archiv f. exper. Path. u. Pharm., Aug. 24, '93).

In cases of alcoholics mild cholera, like traumatism, is capable of producing delirium tremens, and may also account for a sudden aggravation of light cases. L. Galliard (Archives Gén. de Méd., Oct., '93).

Natural immunity against cholera which, according to Koch, exists in half of the human race. The exact way in which this acts is not yet clear, but it is probable that the toxin generated in the intestinal canal by the vibrios of cholera becomes changed by the nuclein, during absorption, into an immunizing substance, or antitoxin. It is a peculiarity of the living cell to be able to preserve a free acid in an alkaline medium. When the life of the cell is destroyed the barrier is removed to the

entrance of the cholera bacilli. Klemperer (Deutsche med. Woch., May 17, '94).

Some persons exposed to action of vibrios remain unaffected. Immunity is not due to killing of all microbes in the stomach. Abel and Clausen (Centralb. f. Bact. u. Parasitenk., B. 17, p. 77, '95).

We see that under certain meteorological changes the epidemics show often quite marked exacerbations, and that, when the private and public sanitary conditions correspond to scientific requirements, the disease is always less grave and more localized than under contrary circumstances.

The marked influence of winds and moisture is undeniable. Rosanoff (La Tribune Méd., Jan. 2, '95).

Prevalence and mortality of Madras Presidency associated with two monsoons caused by rains, induced rise of subsoil-water and development of conditions suitable for seasonable epidemic. W. G. King (Brit. Med. Jour., Feb. 2, '95).

Pettenkofer's view of the important part played by the level of the ground-water in the cholera epidemic in 1892 supported by comparative charts showing the amount of rain-fall, the number of cholera cases, and the level of the ground-water. As the ground-water sank, cholera increased. P. Hauser (La Méd. Mod., June 9, 13, '94).

Symptoms.—The duration of the period of incubation ranges in the majority of cases from 36 to 56 hours; it very rarely extends over several days.

The *clinical course* of cholera may be divided into three periods: (1) *premonitory diarrhœa*; (2) *confirmed cholera*; (3) *reaction*.

Premonitory diarrhœa begins more frequently at night, with or without colicky pains, under the form of liquid stools, at first fœcaloid and then bilious and serous, with borborismus, but without tenesmus. Generally there is no fever, and no trouble of the appetite and of the general well-being; so that pa-

tients may not be obliged to go to bed. But, after it has lasted for a more or less long time (from a few hours to several days), the patient begins to feel a sense of weakness, pains in the limbs, dizziness, shiverings, and mental torpor. Premonitory diarrhœa is always of choleraic nature, as the stools contain the specific germs and may disseminate the infection. It is not constant, being found only in one-third or two-thirds of the cases (according to the different statistics); but it may be the sole manifestation of a very slight cholera.

Confirmed cholera is announced by a change in the aspect of the stools, which, while becoming more frequent, consist of an aqueous fluid, without any fœcaloid smell or appearance, in which many whitish, mucous flakes float, resembling grains of rice (whence their name of "rice-water" or "riziform" stools), formed by the epithelial *detritus* and containing the cholera vibrios. In the meantime vomiting sets in, also of an aqueous material and accompanied by cramps in the stomach and præcordial uneasiness. The thirst becomes burning and insatiable. The urine is scanty, often showing albumin and sugar (which disappear when recovery begins); but in many cases these are totally wanting, a complete anuria being the rule in grave forms. The tongue is whitish, large, and damp. Palpation of the abdomen shows the anterior wall depressed and somewhat hardened. In proportion to the increase of the diarrhœa and vomiting the patient grows weaker and weaker; the extremities become cold; the pulse small, weak, and accelerated; painful cramps develop in the calves; sinking of the features with sharpened, cold nose, sets in; and the circulation becomes sluggish, constituting together the "algid stage."

This period may last from a few hours to one or two days, and may end in recovery with a progressive amendment of all the symptoms, constituting then the form to which the name "cholerine" was given by some authors; or it may end in death with symptoms of profound exhaustion, or finally pass, as we have said, into the algid stage.

This is announced by a lessened frequency and abundance of the dejections, which sometimes cease altogether. In a few hours, however, the patient's general condition grows rapidly worse; the countenance is altered,—the cheeks become hollow, the eyes sunk deeper in the sockets, are encircled by a black ring; there are pains in the head, ear-tinglings, dizziness, and blurred vision; the voice becomes hoarse and is soon extinguished. A feeling of anxiety assails the patient, who suffers from the most excruciating vomiting, hiccough, and cramps in the calves. Cooling of the surface increases, all external parts being, as it were, frozen; but the patient feels an internal, very troublesome heat, explained by the fact that the temperature of the skin, mouth, etc., is much lowered, while that of internal organs is raised and even febrile. At the same time the skin takes a bluish tinge, with black marble-like veins coursing over the hands, feet, penis, and with increasing cyanotic dark hue of the nails. The pulse becomes weaker and smaller, until it disappears, first from the radial arteries and then from the crurals and even the carotids, while the heart-beats gradually disappear, the sounds becoming weaker until finally only the second sound is heard. To this great emaciation is added, the body growing thin and the skin wrinkled. Breathing is frequent and difficult; every secretion is dried up, with the exception of that of the sudoriferous

glands, a cold and clammy sweat covering the cutaneous surface. At the end of this stage the patient becomes extremely apathetic and somnolent, loses consciousness, slowly turning his eyes toward a person speaking to him, and at times answering some words with great fatigue, but immediately falling again into stupor. A period of agitation, during which the patient tries to rise and utter vague words sometimes precedes this stage of collapse, which generally—in more than three-fourths of all the cases—grows worse, and ends in death. The whole duration of the algid stage is from a few hours to two or three days.

Signs of death in choleraic patients. The cessations of respiratory and cardiac movements are not certain signs of death in this disease. The author proposes the following: 1. With an œsophageal sound, introduce by the mouth an abundant quantity of water into the digestive tube. The epithelial *débris* which covers the mucosa will become softened and the water be absorbed. 2. Place the body in a bath, at a surrounding temperature, the head naturally above water. 3. In a patient considered dead from cholera, make a small incision in the abdominal wall and inject an abundant quantity of warm water into the peritoneal cavity,—an operation which, in the event of revival, would be inoffensive. Netter (*Revue Méd. de l'Est*, Aug. 18, '92).

Reaction.—When death does not take place during the algid stage, symptoms of improvement may show themselves: the cyanosis disappears, the skin gains some warmth, the urine begins to flow again and is deep colored, charged with urea and chlorides and very often albuminous; at the same time the pulse resumes its strength, while its frequency decreases; the voice returns, breathing becomes regular, painful cramps disappear, little by little the different functions are re-established, and after some

days the patient enters into a state of complete convalescence.

But the reaction does not always take such a favorable course. Many of the choleraic symptoms (anuria, cooling of the skin, difficult breathing, etc.) persist or reappear, and digestive troubles, headache, nervous disorders, fever, and general depression follow, ending in a form very like typhoid fever; whence its name of *cholera-typhoid*. Such cases may run toward a lethal termination, delirium or coma and adynamic symptoms supervening; but they may also end in recovery. In other cases the reaction may be very sluggish, each function requiring a long time to become regular, and a remarkable degree of weakness, somnolence, with scanty, albuminous urine, persist until convalescence sets in.

But how are the symptoms of cholera to be explained? Several theories have been proposed to solve the question; but it cannot be said to be definitely settled. It seems, however, that no better explanation can be given than that of the effects of the cholera vibrios after their penetration into the intestine; that is, a direct injury to the mucous membrane of the gut and the elaboration there of one or more poisonous substances ("choleraic toxins"), which enter the circulation. The direct injury, under the form of a specific enteritis, gives rise to dehydration of the organism, for the great loss of water through vomiting and diarrhoea, which not only deprives the blood of its water, but indirectly subtracts from the tissues their water-component. As a result, the blood can no longer get rid of the regressive products physiologically eliminated by it, nor perform the function of hæmatosis, while the anatomical elements are affected in their metabolism. On the other hand, the toxins, acting on the nervous system,

mainly through a lesion of the sympathetic system of the abdomen, exert a general depressing influence.

The cholera vibrio is considerably modified by micro-organisms which may surround it. The immunity and susceptibility depend upon other microbes in the intestinal tract. Koch's bacillus nevertheless remains the specific cause of cholera. Metschnikoff (*Ann. de l'Inst. Pasteur*, Paris, p. 529, '94); Fawitzky (*Wratsch*, Nos. 47, 51, '94); Rontaler (*Münchener med. Woch.*, May 21, '95).

There is no antagonism between the cholera vibrio and the comma bacillus. Kempner (*Centralb. f. Bakt. u. Parasitenk.*, B. 17, H. 1, '95).

Several complications may be observed during the period of reaction, among which the following are more common: Cutaneous eruptions (papulous erythema, urticaria, miliaria, zona, roseola, petechiæ, vibices, boils, etc.), œdema of the glottis, diphtheritic angina, mumps, thrush, dysenteric enteritis, bronchitis, pneumonia, cerebral congestion, meningoencephalitis, hæmorrhage, and softening of the brain, which may give, of course, a great variety of clinical aspects to the disease.

Cholera assumes an epidemic form of grave dimensions in Canton now and then. Small outbreaks have occurred since the great epidemic of 1894. During this year that country suffered from prolonged drought and intense heat. A comparison of the clinical course of cholera and the effects of the treatment has shown that the onset in every case was sudden, particularly in the earlier cases when the disease was most virulent, vomiting and diarrhoea being early signs. Delay in the treatment of this stage meant certain death, and the writer states that he has not seen one patient recover when treatment was delayed,—that is: during the early weeks of the epidemic, while toward the end of the epidemic the virulence of the dis-

ease decreased, and spontaneous recovery sometimes took place. The earlier the onset of cramps, the worse the prognosis, and experience shows that the patient does not recover when cramps are a well-marked condition. W. J. Webb Anderson (Lancet, Sept. 27, 1902).

Convalescence, as a rule, is long and often complicated with dyspepsia, diarrhœa, palsies or spastic disorders in the limbs (sometimes in form of tetany), and mental troubles. Anæmia is present in a large proportion of cases.

An attack of cholera does not give immunity; so that even after recovery has taken place a new infection is possible.

The *clinical forms* of cholera may be very different. The most common is that described, in which the disease runs through its typical periods; but it may limit itself to the first stage, being a choleraic diarrhœa or a *cholérine*, or it may, from the beginning, show the gravest symptoms of confirmed cholera, rapidly passing into the algid stage. Between the slight and the grave form there are all the possible intermediate varieties. But there are two other forms worthy of mention: the "foudroyant" and the "dry" cholera. The true cholera foudroyant or *cholera siderans* is generally rare and mostly observed in India; the disease then kills in a few hours or even minutes; or—as observed in European epidemics—death ensues after 12 to 24 hours. The name of "dry" cholera is given to those cases in which there are no diarrhœic stools; intestinal exudation really takes place, but, probably on account of intestinal paralysis, the fluid materials are not thrown out. These cases are often rapidly fatal.

Diagnosis.—In grave cases of cholera the diagnosis is not difficult, especially when an epidemic of the disease exists. Sometimes, however, the clinical appear-

ance of the disease may be very like that of malarial choleraform pernicious fever and of various kinds of chemical poisoning. The confusion between cholera and malaria may arise especially in countries where both infections are endemic, such as in India. Then, besides the bacteriological examination showing the specific germ in each of them, the effects of quinine may indicate an important difference in the character, malarial fever ordinarily yielding to its action, while cholera generally runs its course despite the largest doses. It may happen, however, that both diseases attack a person at the same time, and then symptoms of each are observed, giving rise to a mixed form, while necropsy shows the lesions of either infection distinctly developed. Poisoning by tartar emetic or arsenic, the symptoms of which resemble very much those of the choleraic algid stage, is recognized by the lesions of the mouth and lips, by the vomiting being painful, burning, and preceding diarrhœa, and, in doubtful cases, by chemical analysis of vomited matters.

But a much more important diagnostic question, arising especially at the beginning of an epidemic or when an invasion of cholera is to be feared, relates to slight or suspected cases, which are marked only by a simple diarrhœa possessing no specific character. It is of the greatest importance to ascertain, on account of prophylactic measures to be at once adopted, whether they are or not of choleraic nature. The diagnosis can only be made by means of bacteriological examination; fortunately this is quite easy, because the cholera vibrios always show themselves in the first diarrhœal stools, and because in many cases the simple examination of a cover-glass preparation of the stools may be sufficient to make a very probable diagnosis.

When mixed with the serum of immunized guinea-pigs, and inoculated into the peritoneal cavity of susceptible animals, virulent cultures of the spirilla in large dose remain innocuous; on subsequent examination of the peritoneal contents the bacteria can be seen to have undergone disintegration to a greater or less extent, dependent upon the relative immunizing strength of the serum of the immunized animal. This power of destroying the cholera spirilla is believed to depend upon the presence in the serum of certain antagonistic substances which have a distinct inhibiting influence upon the vital processes of the bacteria.

Investigations show that no other species of bacteria is affected in the same way by mixing with the serum. Hence the following test proposed: A loopful of the culture to be tested is mixed with a cubic centimetre of bouillon, to which ten times the amount of serum necessary to protect a guinea-pig of 200 grammes weight from a similar dose of virulent cholera spirilla has been added, and the whole is at once inoculated into the peritoneal cavity of a young guinea-pig of from 200 to 300 grammes weight. In the inoculation care should be taken to avoid injury of the intestines, and the cultures employed should be recent and should have been shown to consist of well-formed and actively moving germs.

As control, a similar quantity of the same culture is mixed with a cubic centimetre of bouillon as before, an amount of ordinary guinea-pig serum equal to the amount of immunizing serum made use of in the original test is added, and the whole is inoculated into another guinea-pig.

In twenty minutes some of the peritoneal contents in each case is withdrawn by means of glass pipettes, and is examined. If the bacteria are the specific germs of cholera they present a very different appearance in the two cases. Those obtained from the control-animal are well formed, active, and seem to have multiplied. Those which were exposed to the action of the immunizing serum are small, misshapen, immobile for the most part, and apparently dead.

Unless a distinct difference is observ-

able between the bacteria in the two experiments the micro-organism under examination must be regarded as probably *not* the cholera vibrio, since the change described is very constant in the case of the cholera germ, and has not been observed to occur with any other under similar conditions. Pfeiffer (*Zeit. f. Hygiene u. Infectiönskr.*, vol. xix, p. 75, '95).

Serum diagnosis: When the blood-serum of an animal gives a good reaction in the fresh state, the reaction may also be obtained by moistening a drop of the dried blood with water and mixing it with an actively motile choleraic culture. Wyatt Johnston and E. W. Hammond (*N. Y. Med. Jour.*, Nov. 28, '96).

According to Blachstein, chrysoidin produces agglutination in cholera cultures in exactly the same manner as the diseased serum of immune animals, and does not produce agglutination in any other form of vibrio. Personal experiments showing that the chrysoidin reaction was not specific for cholera. Several vibrios are affected, and among them is included the vibrio of Asiatic cholera, and it is not the most sensitive. Walter Engles (*Centralb. f. Bakt., Parasit., u. Infectiönskr.*, Jan. 20, '97).

In 11 cases examined the agglutination of the cultures of the cholera vibrio was shown 10 times by the serum; twice on the first day of the disease, 4 times on the second day, 3 times on the third day, and once on the fourth day. The reaction was particularly distinct in 2 of the patients from whom the blood was taken on the third day. The phenomenon of agglutination ascertained by them was absolutely typical. Achard and Bensaude (*Presse Méd.*, Sept. 26, '97).

Bacteriology.—The specific germ of cholera Asiatica is now—thanks to the researches of Koch and of many other authors—perfectly known. It is found especially in the mucous flakes of the stools (and in the vomited matter). When these are spread upon an object-glass, dried, and stained with one drop of methyl-blue, it appears in the shape of rods, measuring 1.5 to 2.5 microns in

length, and 0.5 to 0.6 micron in width, and being generally curved, whence the name of "comma bacilli" or "bacilli virgula" given to them. Sometimes, when two of them are joined at their extremities, in a direction opposed to their concavity, the resulting form is that of an italic *S*, and when several bacilli are joined to each other, their shape becomes that of a spiral (choleraic "spirilla"). Cholera bacilli are very movable and endowed with oscillatory movements resembling those of spermatozoa, and also with progressive movements. They are easily cultivated in several culture-media, as in broth and upon agar-agar at the temperature of the human body, upon gelatin plates, which become slowly liquefied, and upon potatoes, meat, eggs, milk, and several other kinds of food. The broth-cultures produce indol and nitric acid (indol-nitrous reaction) and give rise to a peculiar reaction with hydrochloric acid, assuming a violet-pink color, whose intensity rapidly increases during half an hour. This reaction, to which the name of "cholera red" was given, is a valuable diagnostic sign of cholera vibrios.

Cholera vibrios can live only for a short time in faecal matter, seldom longer than two or three days; so that the advisability of immediate examination of the dejecta is evident. They live, on the contrary, very long in the soil, especially when they find in it a proper nutritious material; it seems rather that their virulence is then heightened, the elaboration of their poison becoming more rapid and intense. They can live, also, on the outer surface of fruits and vegetables (the duration of their life being then from one to six days) and even on the cut-surface of these, where their life may last for a time ranging from one hour (on very acid fruits) to two weeks.

Cholera vibrios can grow freely in water, especially when it is stagnant and polluted with organic matter; and it has been shown that they can live for many days even in bottled water.

The bacilli are destroyed if they are in free contact with the air while exposed to the sunlight, but the colonies in the interior of the culture-media are aided in their growth, the sunlight serving as a sort of incubator. When the medium is plentiful, there is more growth than destruction. Virulence is not diminished in those bacteria that show growth. Therefore bacteria in the deeper portions of water are not affected by the solar rays, while those floating on the surface may be destroyed; conclusion drawn that "too much reliance should not be placed on the bactericidal action of sunlight." F. F. Westbrook (Jour. of Path. and Bact., Jan., '96).

As for the action of high or low temperature upon them, we know that the best temperature for their growth is between 30° and 40° C.; that under 160° C. their growth is checked, but their vitality is preserved, even if zero or below zero is reached; they have been found to resist a temperature of -31.8° C. (24° F.), so that it may be supposed that the germs may survive an entire severe winter. On the contrary, they are killed after some days by a temperature of 50° C., and in a shorter time by a temperature of 75° C. Direct sunlight diminishes, but does not destroy, their vitality and virulence.

A distinct degree of alkalinity is necessary for their best growth (this being the reason of their development in the intestine), while nearly neutral media are very unsuitable, and acids are decidedly inimical to them; hence they cannot live in the stomach. Sulphuric, hydrochloric, and phosphoric acids, fresh lemon-juice and wine and beers containing a somewhat large proportion of acids, are all able, in a different degree, to kill

them. Among the chemical substances having a marked microbicidal action upon cholera vibrios, the most energetic are corrosive sublimate (1 to 10,000), sulphate of copper (1 to 25,000), and quinine (1 to 5000). Mustard-oil and volatile essences generally display a similar action.

Experiments showing that a distinct degree of alkalization was necessary for the best growth of bacilli, while nearly neutral media were very unsuitable. Sulphuric and phosphoric acids were decidedly inimical to the development of the germs. A. Stutzer and R. Burri (Zeit. f. Hygiene u. Infectiönsk., B. 14, '93).

Asiatic cholera is a *nitrate* poisoning, the result of the growth of the specific bacterium. Emmerich and Tsuboi (Münchener med. Woch., June 20, '93); Klemperer (Berliner klin. Woch., p. 74, '93).

If the theory of Emmerich and Tsuboi upon cholera as the result of nitrate poisoning produced by the bacilli is true, more than one cause must act to produce cholera. Not only are the bacilli necessary, but the nitrites also, upon which they are to act to produce nitrates. The presence of carbohydrates is a further essential. R. J. Beck (Med. Corres. des württembergischen Arzt. Landesvereins, Dec. 18, 28, '93).

The specific nature of the comma bacilli is proved by their being found exclusively in the intestinal contents of choleraic patients; but it is proved, too, by experimental production of a cholera-like disease in animals through ingestion or inoculation of their cultures. Indeed, Koch, having previously alkalized the stomach-contents of guinea-pigs, introduced 10 cubic centimetres of broth-culture of comma bacilli and immediately afterward injected into the peritoneum 1 cubic centimetre of tincture of opium, and succeeded in producing an intestinal lesion with a flaky, diarrhœal fluid: a pure culture of comma bacilli. Other experimenters, by inoculating such a culture into the peritoneum,

observed in guinea-pigs and rabbits a very grave disease, with extreme weakness, low temperature, and death in collapse. Inoculations of choleraic virus in man, however, gave no result.

Cholera vibrios vary to a considerable extent in their pathogenic attributes and chromogenic properties, not only when they grow saprophytically outside the body, but also when they are obtained directly from the intestine of a choleraic patient; so that many forms of them have been described as different organisms, while they are only peculiar varieties of the same germ. Moreover, it seems highly probable that their symbiosis with certain species of microbes found in the dejections and in the intestines of cholera patients play an important part in the increase of their virulence, while some other intestinal microbes may, on the contrary, retard their growth and lessen their virulence.

Attention called to the inhibiting action of lactic acid upon the cultures of the spirillum. Ferrani (Revista de Ciencias Médicas, Sept., '92).

The cholera spirillum secretes a substance which is inhibitory to the growth of the bacillus coli, bacillus typhosus, bacillus anthracis, and bacillus pyocyaneus. Gabritschewsky and Maljutin (Centralb. f. Bact. u. Parasitenk., June 15, '93).

There are not different species of the true cholera vibrio, but the changes which occur when it is grown under different circumstances are not constant and are unessential, the typical forms being obtained again from the changed ones. Friedrich (Centralb. f. Bakt. u. Parasitenk., May 19, '94).

Pathology.—The characteristic lesions of cholera are found in the small intestine, whose inner surface is covered by a whitish, creamy lining, extending from the pylorus to the ileo-cæcal valve. Its contents are generally made up of the well-known rice-water material; this has

a neutral or slightly-alkaline reaction, and contains only 1 to 2 per cent. of solid matter (chloride of sodium, carbonate of ammonium, a little urea, and traces of salts of potash); it is devoid of albumin, coloring substances, and biliary salts. The mucous membrane, after the lining has been removed, shows a red coloration, more or less marked, according to the period of the disease, and a number of small, round prominences, made by swelled folliculi: "psorentery." In a later stage the lesions are more pronounced: the intestinal contents are bloody, the folliculi are ulcerated, and the mucous membrane shows a more or less extended gangrene. The large intestine is also extremely hyperæmic, studded with hæmorrhagic patches and ulcerations, and is filled with black, bloody, fœtid, fæcal matter. Deepening of the ulcerations may give rise to perforation, with all its dire sequelæ. Microscopical examination shows a variable degree of swelling and clouding of the epithelium, and extensive desquamation of the small intestine. The adenoid tissue of the mucous membrane and of the villi is filled with embryonic cells, and this cellular infiltration is also found in the follicles and in Peyer's patches. The muscular layer is unaffected; the subserous connective tissue is infiltrated with leucocytes, while the epithelial layer of the peritoneum has disappeared. Anatomically, therefore, the intestinal lesion may be regarded as an acute desquamative enteritis.

The fluids, especially blood and urine, may be very toxic and reproduce typical symptoms of mortal cholera in animals. Bosc (*Ann. de l'Inst. Pasteur*, June 25, '95).

There is always a more or less severe glomerular nephritis in the algid stage. Pernice and Scaglioni (*Riforma Medica*, Oct. 19, '94).

In the kidneys the pathological changes are those of a more or less severe glomerular nephritis, or, according to Leyden, of a coagulation necrosis of the epithelium without any inflammatory action. In the former case the morbid changes would be explained by the elimination of toxins passing from the intestine into the blood; in the second by alterations in the circulation due to the profuse loss of water. An epithelial desquamation is observed on the mucous membrane of the bladder, ureters, and the pelvis of the kidneys. The spleen is hard and rather small; the liver is congested and its cells have undergone granular degeneration.

As for the cerebral changes, both in the algid stage and in the period of reaction, they are likewise of the nature of acute degeneration and necrosis.

Cerebral changes in Asiatic cholera in algid state, as well as in reaction period, of the nature of an acute degeneration and necrosis, and not of a perivascular inflammation. Tschistowitsch (*St. Petersburg med. Woch.*, Aug. 17, '95).

Prognosis.—Cholera Asiatica is always a serious disease, even when its symptoms do not apparently show a specially grave character. Considering its insidious tendency and the probability, never lacking, of lethal accidents in every period of its course, the slightest forms of diarrhœa may be regarded, during an epidemic, as the onset of a fatal affection. In the algid stage, of course, the prognosis is still more unfavorable, and such symptoms as anxiety, agitation, collapse, weakness; quickness and, moreover, disappearance of the radial pulse; anuria, coma, delirium, and convulsions are almost without exception of very ill omen. As for the period of reaction, the prognosis becomes bad when cerebral or pulmonary complications occur, or if its course is irregular.

At the beginning of an epidemic, the average mortality from cholera is 50 to 60 per cent. and even higher, while at the end, slight forms generally prevailing, it grows progressively less. The largest proportion of deaths occurs in children and old people, the ill-nourished, enfeebled, paupers, drunkards, and those affected with debilitating diseases, especially dysentery, cancer, consumption, insanity, etc.

Whatever may be the gravity of the symptoms during the algid stage, even if there be intense cyanosis, if the normal or contracted pupils remain mobile,—that is to say, if they dilate when the eyelids are closed and return to their primitive diameter as soon as the lids are opened,—a favorable prognosis may be given. Coste (*Revue de Méd.*, No. 12, '90).

The prognosis of Asiatic cholera in young children is exceedingly bad. Of 4129 infants, aged 1 year and under, 80 per cent. died; of 1701 children, from 1 to 5 years, 75 per cent. died; of 1731 children, from 5 to 15 years, 45 per cent. Hoppe (*Deutsche med. Woch.*, Nov. 9, '93).

There is a urinary crisis in patients who recover, characterized by the discharge of abundant urine of low specific gravity, rich in urates, but poor in chlorides. As convalescence becomes more marked, the proportion of urea diminishes, that of the chlorides increases, the specific gravity grows greater, and the quantity of urine returns to normal. Carrieu (*La Méd. Mod.*, Dec. 30, '93).

Prophylaxis.—Prophylactic measures are of the utmost importance. The importation and propagation of cholera must be thwarted and healthy persons must be protected against contagion. The measures necessary may be summed up as follows: A careful examination of persons coming from infected places; isolation of those found ill or simply suspected and of their nurses; thorough disinfection of clothes, linen, premises, dejections, rooms, drains, etc. For in-

dividual prevention it is necessary to drink only boiled water, to avoid every dietetic error, excess, mental or bodily strain, cold; and, while no radical change ought to be made in the ordinary alimentation, the food must be of good quality and vegetable products should always be cooked.

Haffkine's prophylactic method, based on the inoculation of serum of immunized animals, has been tried with satisfactory results in India; but the duration of the protection afforded by the inoculation, and for some authors the efficiency of the protection itself, is still a matter of doubt.

An experimental inquiry of the bearing on immunity of intracellular and metabolic bacterial poisons: As far as the cholera spirillum is concerned, (1) any one mode of immunization will protect an animal against an infection by any other form of inoculation used; (2) the serum of an animal immunized by any one method also protects guinea-pigs against an infection by any other forms of inoculation; (3) the distinction between an "intracellular" and a "metabolic" poison in their relation to artificial immunity must not be made too narrow. Kanthack and Westbrook (*Brit. Med. Jour.*, Sept. 9, '93).

The milk from an immunized goat has the property of conferring immunity to cholera, but not when introduced into the system by way of the stomach. It confers immunity at once, but is of no avail if given shortly after the injection of the cholera germs. Ketscher (*Archiv f. exper. Path. u. Pharm.*, Nov., '93).

Conclusion against Haffkine's anti-cholera inoculations; we have no certainty that we are protected against the specific poison in the intestines, however carefully we may be protected against the effect of intracellular poison. Klein (*Brit. Med. Jour.*, Mar. 26, '93).

Endeavor to reconcile the various divergent views which have resulted from the studies of different observers: There are in the cholera vibrios distinctly-poisonous substances, which are insoluble in

the ordinary culture-media, but which are set free after the death of the bacilli in the bodies of guinea-pigs used for experiments, and which then act as paralyzants to the centres governing the circulation and the temperature. Conclusion that, although the possibility of a successful protective inoculation against human cholera cannot be denied, the existence of such a possibility has not yet been proved experimentally. R. Pfeiffer (*Zeit. f. Hygiene u. Infektionskr.*, Mar. 2, '94).

Inoculation by injection of serum obtained from convalescents. Freymuth (*Deutsche med. Woch.*, Oct. 25, '94).

Solid substance obtained from residue of culture-fluid freed of micro-organisms as immunizing agent. Ransom (*Deutsche med. Woch.*, July 18, '95).

Substances found in blood of convalescents afford inconstant immunity. Sobernheim (*Hyg. Rund.*, p. 145, '95).

Haffkine's inoculations in India increased safety of inoculated twenty times. W. J. Simpson (*Brit. Med. Jour.*, Sept. 21, '95).

Out of 3276 uninoculated persons, 47 cases; out of 2936 inoculated, 3 cases. Powell (*Indian Med. Gaz.*, No. 7, '95).

Kitasato's anticholera serum used in 193 cases. The former rate of mortality (among Japanese) has been about 70 per cent. In these cases the percentage was lowered about 20. The subsidiary results were similar to those of diphtheria antitoxin: 1. Urticaria, very common. 2. Arthralgia, observed in only 18 cases. 3. Myalgia in 6 cases. A. Nakagawa (*Brit. Med. Jour.*, No. 1855, p. 121, '96).

Summary of all the observations in India upon Haffkine's anticholera inoculations. 1. The inoculations even in the larger doses hitherto used do not confer a complete immunity. 2. A considerable degree of immunity seems to be conferred when the doses injected are sufficiently large to produce marked febrile reaction. 3. Smaller doses confer little or short-lived protection. Arthur Powell (*Lancet*, No. 3803, p. 169, '96).

Complete report of the results of the anticholeraic inoculations performed in Calcutta during two years. Among 654

uninoculated persons there were 71 deaths, while among the 402 inoculated individuals in the same households there were 12 deaths: a reduction of mortality of 72.47 per cent. The results in Calcutta are fully confirmed by reports from other parts of India, which are also given. Simpson (*Indian Med.-Chir. Rev.*, July, '96).

Epidemic in 1895 in the town of Midnapore, Bengal, in which the method suggested by Hankin of disinfecting the wells by permanganate of potassium was used. It undoubtedly cut short the epidemic, statistics showing the value of the method. O'Gorman (*Indian Med. Gaz.*, July, '96).

Referring to the researches which have shown that the protective action of the cholera serum is strictly specific, and is due to the presence of specific bactericidal substances: The serum of persons inoculated with cholera vibrios contained these substances, and not bodies antitoxic to the cholera poison belonging to the vibrios themselves. The value of inoculations emphasized in India, although the protection lasts only a year. Kolle (*Deutsche med. Woch.*, Jan. 1, '97).

Detailed statement of results of anticholera inoculation. In Gaya jail, of 433 prisoners, 215 submitted to inoculation, after cholera had appeared in the prison. Among the inoculated there occurred 8 cases, with 3 deaths; among the unprotected, 20 cases, with 10 deaths. Haffkine (*Dublin Jour. of Med. Science*, Feb., '97).

The number of micro-organisms in well-water may be materially reduced for several days by placing potassium permanganate in the well. Attempt to check choleraic outbreaks in India by putting the permanganate salt in the wells of villages in which the outbreaks occurred. Enough was used to give the water a pink color until the following day, generally two or three ounces, and the procedure was repeated every third or fourth day. As a result, the cholera outbreaks were of shorter duration, and cases fewer in these villages than in those using water from wells that had not been so treated. E. H. Hankin (*Brit. Med. Jour.*, Jan. 22, '98).

Inoculation against cholera strikingly influenced the total number of cases and deaths, but the proportion of deaths to cases was not influenced. Conclusion therefore reached that there are two kinds of immunity: one against the living microbe and one against the fatality of the symptoms of the disease caused by the products of the microbe. Haffkine (Lancet, June 24, '99).

Treatment.—The treatment of cholera is still a much-vexed question, no specific remedy having been found to directly combat the infection, while serum-therapy is only yet in its incipient stage. It would be impossible to refer to the numberless methods which have been proposed and tried with variable result; I must, therefore, limit myself to the general rules which experience, a knowledge of the biology of the pathogenic microbe, and of the influence it exerts upon our system have indicated to be the most rational.

From this knowledge the aims of treatment would be as follows: 1. To restrain the development of the germs in the intestine and to neutralize the poisons to which they give rise there. 2. To counteract the poison which has penetrated into the blood-current. 3. To mitigate the effects of the twofold (local and general) action of the germs.

1. To restrain the development of the germs in the intestine and neutralize the specific toxins, no better means is at our disposal than acids, whose microbicidal properties against cholera bacilli are well shown. Therefore, internal use of acids under the form of hydrochloric, citric, or tartaric lemonade is highly to be recommended, together with the injection into the intestine, by means of a special irrigator (enteroclysis) of a warm solution of tannic acid ($1\frac{1}{4}$ to 5 drachms for $1\frac{1}{2}$ to 2 quarts of water or infusion of chamomile). These injections were proposed by Cantani, who

gave the preference to tannic acid on account of its neutralizing the alkaline reaction of the intestine, corrugating blood-vessels (and so restraining the absorption of poisons), and acting as an antidote against the toxins. They must be repeated four times a day, and, in grave cases, after each alvine evacuation. The beneficial effects of this treatment I was able to observe in the cholera epidemic of 1884 in Naples, and my experience is that, if it be resorted to at the first appearance of premonitory diarrhoea, the course of the disease may be aborted, while in declared cholera many lives may be saved through its aid, when general poisoning has not yet taken place. French authors replace the hydrochloric, citric, etc., acids by the lactic lemonade, prepared with $2\frac{1}{2}$ drachms of lactic acid to a quart of water. On the other hand, Genersich has modified Cantani's method by injecting a larger quantity of fluid (5 to 15 quarts of a 1- to 2-per-cent. solution of tannic acid) under a greater pressure; so that the liquid may irrigate the whole intestine and be at least partly ejected by the stomach. This method, to which he gave the name of *dyaclysis*, has for its object to cause the remedial substance to act upon the whole mucous membrane of the gut; but its practical application is rendered very difficult, and it is not well borne.

Effort to cleanse the digestive tract of its pathogenic elements by the following procedure: Every patient at once made to drink as many tumblerfuls as possible of hot water, containing each 3 drops of hydrochloric acid. As soon as the patient had successively imbibed 6 or 8 tumblerfuls, manual abdominal pressure was resorted to in order to expel the liquid. Ten minutes after the vomiting had ceased the whole cleansing procedure was repeated. Sometimes a third washing was performed three hours later. Simultaneously the intestines were

cleansed by means of enemata, made of from 12 to 18 tumblerfuls of a hot 2.5-per-cent. aqueous solution of tannin, or, in the absence of the drug, of the same amount of plain, hot water. The injection was usually followed by decrease of diarrhoea: but sometimes a second enema became necessary, being then administered about two hours after the first. When practicable, the measures were supplemented by a hot general bath, and a successive application of abdominal compresses soaked in hot, strong solution of kitchen-salt, and wrapping the whole body with hot sheets and blankets. Internally, the patients were given claret (boiled with cinnamon and sugar) and lemonade made of hydrochloric acid (10 drops to each tumblerful), a mouthful every ten minutes. In addition, some stimulant remedy (camphor, ether, caffeine with benzoate of sodium) was administered hypodermically. But 10 cases out of 66 thus treated lost. I. F. Shorr (Yüjno-Rüsskoia Med. Gaz., No. 13, '92).

Introduction of a soft-rubber tube one metre in length into the rectum, causing it to pass through the sigmoid flexure and enter the descending colon, and carry liquid as far, at least, as the ileo-cæcal valve. A large quantity (2 or 3 gallons) of warm soap-water thus introduced effectively cleanses the intestinal canal; the secondary effect of irrigation of the colon is to cleanse and relieve the small intestine of its contents. Of 26 cases thus treated, 23 recovered. Elmer Lee (Med. Rec., Dec. 17, '92).

Experiments carried out with a view of determining the competency of the ileo-cæcal valve, showing that in a certain number of cases success may be looked for, even though the first attempt prove a failure. In four cases there was no difficulty whatever in the passage of liquids from the anus to the stomach or even out through the mouth and nose. Judson Daland (Amer. Jour. Med. Sci., July, '93).

Choleraic patients obtain real benefit from the use of tar-water given internally, in small quantities, and in the form of enemata. It generally arrests violent diarrhoea and vomiting, and im-

proves the *bien-être* of the patients. Polubinski (Wratsch, No. 50, '92).

High rectal injections of an acidulated solution of peroxide of hydrogen recommended. A prolonged contact of water with turpentine transforms the former into a fairly-strong solution of peroxide of hydrogen. Shiloff (Inaug. Dis., No. 65, p. 59, '93).

For the purpose of cleansing the intestine of the specific germs, and their noxious products, the use of purgatives has been recommended, especially in the first stages of the disease; calomel and castor-oil are generally preferred, and they may sometimes give good results. But, when they do not act favorably on the first or second day, their effect can no longer be relied upon.

Attention drawn to the views held by many, viz.: the risk that attends the use of purgative medicines, and salines especially, during periods of epidemic cholera, and at places where that disease happens to be prevailing. Physicians who practice in India seem to have recognized the danger of strong purgatives. Editorial (Lancet, Sept. 23, '93).

[A large number of cases seen in which, under appropriate treatment, purging and vomiting had been stopped, and the patients apparently recovered, but who were afterward brought back to a fatal state of collapse by the administration of purgatives of an irritating nature. NEVE, Corr. Ed., Annual, '94.]

2. To counteract the effects of poisons absorbed into the blood we have no efficient means, the greater number of drugs given for this purpose (especially antiseptics) having failed or given but very imperfect results. The only thing we can do is not to exert an antidotal action upon them, but to hasten and make easy their elimination from the blood, by largely diluting it through the introduction of an artificial serum, a practice answering other important objects, as we shall see shortly.

3. Among the noxious effects of local

inflammation and of the general toxæmia, which require an energetic treatment, the principal are: diarrhœa and vomiting, with excessive loss of watery fluids; and danger of heart-paralysis.

To control diarrhœa and vomiting, when excessive, is a vital indication, the profuse loss of water they involve contributing a very serious danger for the organism. Against diarrhœa, the same rectal injections of tannic-acid or acetate-of-lead solutions and internal use of opium.

As a person shows the premonitory symptoms of cholera, by having one or two large watery motions passed with little or no pain, and begins to vomit, it is best to put him under the influence of opium at once. All physicians who have had much to do with the treatment of cholera in India are agreed in this; and it is noteworthy that many so-called cholera "specifics," which have from time to time been popular, contain opium in some form. F. C. Nicholson (Practitioner, Sept., '93).

Carbonate of calcium, salicylate of bismuth, etc., may also be of some service; while, to subdue the vomiting and painful cramps in the stomach, ice, laudanum, morphine (hypodermically), cocaine, chlorodyne, essence of mint, menthol, camphor, or chamomile may be resorted to.

Belladonna advocated. Illingworth (Med. Press and Circular, June 19, '93).

Atropine most useful on account of the control that it would exercise over the cramps of the muscles and in spasm of the bile-duct. Scriven (Brit. Med. Jour., June, '93).

Atropine of marked value in collapse. Lauder Brunton (Brit. Med. Jour., June, '93).

Shortly after the development of first symptoms a subcutaneous injection of camphor, with musk, is rapidly followed by a striking amelioration in the patient's condition, vomiting either greatly decreasing or ceasing altogether, the well-

known distressing oppression about the chest similarly subsiding. Popoff (Inaug. Dis., No. 25, p. 55, '93).

Blisters to the neck, along the course of vagus, cause both vomiting and hic-cough to cease. Blagovidoff (Wratsch, No. 34, '92).

The following treatment employed with advantage, particularly for the relief of the cramps and vomiting:—

R Dilute hydrochloric acid, 15 minims.

Pure pepsin essence, 20 minims.

Wine of opium, 20 minims.

Peppermint-water, 4 ounces.

Syrup of orange-flower, 1 ounce.

M. Sig.: A teaspoonful each hour.

This dose can be diminished as soon as the medicine controls the attack to some extent, so that 4 teaspoonfuls a day may be sufficient. Sometimes 15 minims of ether may be added to this mixture with advantage. Chauvin (La Méd. Mod., Sept. 5, '96).

But the effects of these remedies are only transient, and the use of some of them—especially morphine—should not be prolonged, in order to avoid the danger of increasing the general depression.

Solutions of benzoyl-acetyl peroxide are extremely active as germicides. In cholera it was at first given by mouth as frequently as possible in solution of 1 to 1000, and by high rectal injections every six hours. For stimulation, brandy and strychnine were given hypodermically, and, if the general condition of the patient was good, morphine was sometimes given to relieve pain. Turpentine stupes and hot-water bags were also used to relieve pain. Vomiting was generally stopped by cocaine and cracked ice. In some hospitals the administration of double gelatin capsules containing each 0.25 gramme (4 grains) of benzoyl-acetyl peroxide was resorted to, as it was found that the continued administration of solutions *per os* produced vomiting. The high rectal injections form an important part of the treatment, especially in the second stage, when the bowel movements are approximately few, because the colon then contains a large amount of toxin which is

flushed out by this means. Omitting deaths occurring immediately after admission to the hospital, and counting only those occurring six hours or more after admission, the mortality in one hundred and twenty cases was 45.71 per cent. The native mortality was probably increased, owing to the difficulty in inducing native patients to take any medicine at all. Of six Americans treated, four recovered and two died. P. C. Freer (Government Lab. Bull., No. 2, 1902; Med. News, Feb. 21, 1903).

When diarrhoea and vomiting are unrestrainable, and therefore loss of water is so large as to cause a rapid thickening of the blood and drying of the tissues, an attempt must be made to restore, as much as possible, the normal composition of the blood, to render it more fluid and to make circulation and hæmatisis easier. For this purpose subcutaneous injections of a hot, saline solution were proposed by Cantani and Samuel and experimented on a very large scale and with very good effects by many physicians and by the writer. Cantani's formula is as follows: Distilled water, 1 quart; chloride of sodium, 1 drachm; carbonate of sodium, 45 grains. Of this solution, warmed to 100.4° to 104° F., one or two quarts are injected into the subcutaneous tissue of the flanks. The results of this method are most striking, sometimes even in the algid stage; and, if it does not always save life, it at least gives the patient some relief from his sufferings. Its effect is shown by removing cardiac weakness and feebleness of the pulse, by bringing on the secretion of urine, by elevation of temperature, etc.

Intravenous infusions of Hayem's artificial serum (distilled water, 1 quart; chloride of sodium, 100 grains; hydrate of sodium, 20 grains; sulphate of sodium, 1 ounce) are equally beneficial, but their use is more difficult, and

they are no more prompt in their effects and not without danger. The subcutaneous injections are, therefore, generally preferable.

Case of cholera in which intravenous injections of salt solution were followed by resuscitation sufficient to allow the patient to sit up and make a will. The operation was repeated six times, and it was noted that good effect could only be obtained when the venous system was rapidly distended. Richardson (Asclepiad, No. 4, '91).

To avoid the danger of heart-paralysis, so far as this depends upon the thickening of the blood and the emptiness of the vessels, we may have recourse to the same watery injections; but if they do not succeed, and whenever cardiac weakness is directly produced by the action of the toxins, the heart must be stimulated by hypodermic injections of sulphuric ether, camphorated oil, caffeine, strychnine, or quinine.

Quinine recommended, 1½ grains given every 2 hours for 24 hours, and repeated during a second 24 hours if necessary. If vomiting be present and beyond control, the drug should be injected beneath the skin. Huberwald (Jahrbuch für Kinderh. u. phys. Erziehung, B. 35, H. 3, '93).

Quinine, in doses of about 10 grains an hour, has given best continuous results yet obtained. Fullerton (Med. Record, July 6, '95).

Treatment adopted in 944 cases with a mortality of only 20.7 per cent. 1. (a) Internal administration of Botkin's anti-cholera drops:—

R. Tincturæ quininæ compositæ,
Spiritus anodyni Hoffmanni, of each,
½ ounce.
Quininæ hydrochlorici, 1 drachm.
Acidi hydrochlorici diluti, ½ drachm.
Tincturæ opii simplicis, 1 drachm.
Olei menthæ piperitæ, 10 drops.

M. Sig.: Give from 15 to 20 drops every two hours.

(b) Cantani's high enemata with tannic acid; (c) internal use of salol with sub-

nitrate of bismuth; (d) calomel in small doses.

2. In severe cases stimulate and sustain the cardiac and cutaneous action: Repeated and prolonged general hot baths, heating the patient's body by any available means; free administration of wine, hot tea, or coffee with brandy; and subcutaneous injections of camphor. Sokoloff (*Bolnitchnaja gazeta Botkina*, Nos. 1, 2, '93).

The internal use of brandy, rum, champagne, liquor ammoniæ, inhalations of oxygen, etc., may also prove of advantage in cardiac failure.

Ammonia internally and ether hypodermically, besides the free administration of alcohol, highly recommended, the aim being to support the failing heart. Giachic (*Berliner klin. Woch.*, Sept. 5, '92).

Hydrochlorate of ammonia recommended for the same purpose. Besides the return of heat and perspiration caused by this salt, it increases diuresis, and therefore increases the elimination of the toxic elements of the disease. Dumontpallier (*Le Bull. Méd.*, Oct. 19, '92).

For the same purpose, and to restore the warmth of the skin, hot baths (simple or sprinkled with mustard) and the application of heat in every form (warm coverings, hot-water bottles or hot bricks around the body, Turkish baths, etc.), dry, energetic frictions, application of sinapisms, electric flagellations, etc., have proved very valuable.

The state of the bladder should be carefully watched, and if examination shows the presence of residual urine, it should be emptied through the catheter. True choleraic anuria is best combated by hot, exciting drinks, hot baths, and hypodermic injections of caffeine and pilocarpine, a solution of the latter of $\frac{1}{5}$ grain to 20 minims of distilled water being employed.

During the whole disease no food should be allowed to patients; at the

most, if any food is believed necessary and the stomach is not altogether intolerant, some iced milk can be given.

The treatment of the period of reaction, when it runs a regular course, is only a hygienic one. Feeding must be carefully regulated, only liquid food being allowed the first few days, then passing gradually to more substantial nourishment. When, however, the disease assumes the typhoid form, hygienic rules must be assisted by symptomatic treatment; if adynamia supervene, cold packs and stimulants must be used; when, on the contrary, symptoms of nervous excitement prevail, lukewarm baths with cold affusions on the head, afford great relief. Cerebral congestion is best combated by the application of ice to the head, by local blood-letting, etc.

Hydrotherapy successful in curing a large number of patients already suffering from cramp in the calves, vomiting, cold extremities, and discolored stools. Friction of the skin with a piece of linen soaked in the coldest water; then a sitz-bath, at a temperature of 44.4° to 59° F. during fifteen or thirty minutes. The parts of the body not in contact with the cold water are enveloped in woolen coverings, and the abdomen is energetically rubbed. Winternitz (*Blätter f. klin. Hydrotherapie*, etc., Oct. 10, '92).

By rubbing the affected areas with a piece of ice, cramps—an excruciating symptom—are relieved with rapidity. Pasalsky (*Provincial Med. Jour.*, Nov. 1, '93).

Salol is an excellent remedy against choleraic diarrhæa, provided it is administered in larger doses than are usually given; 2 to $2\frac{1}{2}$ drachms during the 24 hours, 30 grains to begin with, followed every 3 hours by a dose of 15 grains. Walkowitch (*La Sem. Méd.*, No. 56, '93).

Salol in 5-grain doses recommended, repeated hourly as long as required by the necessities of the case. The drug

mitigates all choleraic symptoms. Piatnitzky (Inaug. Dis., No. 8, p. 97, '93).

Against hyperthermia and general poisoning quinine by hypodermic injections should be resorted to. Gastro-intestinal disorders (tyimpanites, abdominal pains, foetid diarrhoea) must be treated by cold applications to the abdomen, by internal use of calomel, and by rectal injections of detergent and disinfecting solutions (hyposulphite of sodium 2 to 5 to 1000, boric acid and tannic acid, 5 to 10 to 1000), etc.

Fifty-one cases with but 5 deaths under immediate use of calomel, not forgetting to give hydrochloric acid at the same time. The calomel is mixed with a little water and gum powder, placing the mixture on the tongue, thus avoiding touching the teeth. The first dose is $15\frac{1}{2}$ grains, repeated several times. Opium avoided. Van Hasselt (Nederlandsch Tyd. voor Genees., vol. xxxii, '93).

The administration of calomel in doses of $\frac{1}{2}$ to 1 grain strongly advocated, given every hour. Treymann (Med. Press and Circular, Apr. 19, '93).

Calhoun many years ago obtained far superior results to those reported. He prescribed calomel, 10 grains; gum camphor and tannin, each 5 grains; every half-hour or hour, as the urgency of the symptoms demanded, until the diarrhoea was checked and the secretions restored to a healthy state. In combination with the above substances he occasionally prescribed opium. F. Peyre Porcher (Med. Rec., Nov. 26, '92).

Calomel most highly recommended as far back as 1855, beginning its use as soon as the choleraic diarrhoea appeared. Two or three doses of $7\frac{1}{2}$ grains each are administered, followed by small doses of $\frac{1}{6}$ grain every two hours. A portion of the calomel becomes changed in the intestine to corrosive sublimate; and as corrosive-sublimate solutions have a fungus-destroying action in a strength of 1 to 30,000, it is easy to believe that the bacilli in the intestine are directly killed by the calomel. Ziemssen (Ther. Gaz., Mar. 15, '93).

During this period, activity of the blood must be guarded against; and to this end enteroclysis with a salt solution of 10 or 15 per cent. is very useful, and, if need be, hypodermoclysis with Cantani's solution can be continued.

Cholera Nostras.

This form of cholera resembles very closely Asiatic cholera in its clinical aspects; so that the distinction between the two diseases is sometimes most difficult. Many authors, indeed, believe in their identity. Guérin, for example, claimed that cholera is always the same disease in every place, and that isolated cases, such as are met with every year in Italy, in the hot season, are identical to those which are developed in India. Leyden, also, does not think that there is a wide difference between cholera nostras and Asiatic cholera. Lastly, Talamon argues in favor of their identity, basing his theory on the fact that epidemics of choleriform diarrhoea occur from time to time without its being possible to attribute them to importation, in places where true cholera had been previously observed. This author refers to two epidemics in the neighborhood of Paris, which had been recognized as cholera nostras, but in which the bacteriological investigation had plainly shown the presence of the comma bacillus.

On the other hand, several authors hold the view that cholera nostras is a disease etiologically different from Asiatic cholera, appearing generally in sporadic cases, but sometimes becoming epidemic. It is produced very often by dietetic errors, or by the action of cold, or by the ingestion of iced draughts in persons exposed to intense heat.

Finkler and Prior found in the stools of patients affected with cholera nostras an organism in the shape of a comma

bacillus, and therefore greatly resembling the cholera vibrio. It differs from the latter, however, by the fact that, when cultivated in gelatin, it very soon becomes liquefied, and does not give the cholera-red reaction. But in many cases, instead of the vibrio of Finkler and Prior, other organisms (*bacillus subtilis*, *bacterium coli commune*) have been found; so that the etiological question is still unsettled and no decided opinion can be formed about the real nature of cholera nostras.

Symptoms of cholera nostras are very like those of Asiatic cholera; very often, however, the stools are not riziform, but bilious and serous; vomiting is not common, and cooling of the skin does not reach an advanced degree. Moreover, the period of reaction is not accompanied by the serious inflammatory changes which are so common in Asiatic cholera; finally, the disease shows a more marked dependence upon seasonal influences. When cholera nostras ends in death, this takes place after the signs of collapse have grown progressively worse in persons weakened by previous illness or in children and old people. Generally the disease lasts only twenty-four to forty-eight hours; then convalescence ensues, leaving often a feeling of extreme weakness.

The treatment of cholera nostras is essentially the same as in Asiatic cholera; and prophylactic measures are of no less practical import, though the contagiousness of cholera nostras does not seem to be as great as that of Asiatic cholera. (See CHOLERA MORBUS.)

A. RUBINO,
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CHOLERA INFANTUM.

Definition.—A particularly grave form of infantile diarrhoea, with symptoms closely resembling those of true cholera;

frequent persistent vomiting, copious serous dejections, high fever, and a rapidly-developing condition of profound collapse.

It is a comparatively-rare disorder, forming not more than from $\frac{1}{2}$ to 2 per cent. of all the diarrhoeal cases met with during the summer months. Unfortunately for the accuracy of our statistics, the term has been applied indiscriminately to all cases of severe infantile diarrhoea. In the opinion of the best writers the name should be limited to such cases as are characterized by intense choleriform symptoms.

[Intelligent work upon this subject is still greatly impeded by confusion in nomenclature. Many excellent articles are diminished in value or rendered actually worthless by the indiscriminate use of the terms "cholera infantum," "enteritis," and other indefinite expressions, rendering it impossible to determine the form of disease to which the author refers. The term "cholera infantum" is the one most frequently used incorrectly. It is limited by nearly every author of prominence to cases characterized by large, serous stools, accompanied by profuse vomiting, high temperature, prostration, and marked nervous symptoms. If writers for the journals would observe the same rule it would save very much confusion, and render their work of decidedly more value. HOLT and CRANDALL, Assoc. Eds., Annual, '92.]

Symptoms.—After a variable, but generally brief, period, characterized by restlessness, abdominal discomfort, and a rising temperature, the infant begins to vomit, and simultaneously or shortly afterward purging commences. The vomiting recurs frequently. At first, the contents of the stomach are ejected; then a bile-stained mucus; and, lastly, nothing but a serous fluid. The evacuations from the bowels soon assume the same serous character. They lose their faecal appearance and acid reaction, and con-

sist almost entirely of a colorless fluid, copious in amount, alkaline in reaction, and generally with a peculiar musty odor. Examined microscopically, little has been found in this fluid beyond a large amount of epithelial *débris*, some round cells, and numerous bacteria. Such discharges soak into the diapers, leaving almost no stain and scarcely any faecal matter to indicate that the fluid has come from the intestines. Although these evacuations are very frequent, recurring every half-hour or hour, pain is not generally a marked feature.

The temperature taken in the rectum is always elevated, generally between 103° F. and 105° F.; nevertheless the body feels cool to the hand. Thirst is extreme; but liquids and foods of all kinds are rejected by the stomach shortly after they are taken. With such a drain upon the fluids of the body the infant rapidly loses weight and strength, and in a few hours its appearance is greatly altered. The face is of an ashy pallor, the eyes sunken, the features pinched, and the expression anxious. The open fontanelle is much depressed; the pulse is quick and weak and may be intermittent; the urine is scanty and in severe cases appears to be altogether suppressed.

During the earlier hours of the disease restlessness is a marked symptom; but, as the strength fails, this is gradually replaced by a condition of apathy, which, later on, may develop into the hydrecephaloid state: the spurious hydrecephalus of older writers. Should the disease take this course, the infant will be found lying in a semicomatose condition, with head drawn backward, pupils sluggish and sometimes unequal, abdomen retracted, and respiration possibly irregular and of the Cheyne-Stokes type. There may also be twitching of the arms and legs. Toward the end the infant be-

comes more comatose, or an attack of convulsions may supervene and usher in the close.

In some cases a condition of hyperpyrexia may precede the fatal termination. In others, the high temperature of the earlier hours may pass away and a more moderate pyrexia, or even, according to some writers, a normal or subnormal temperature take its place. Nevertheless, if the graver symptoms of collapse persist, this fall must be regarded as an unfavorable omen. In such cases we sometimes find that both vomiting and purging cease a few hours before the end occurs.

The course of this disease is very rapid, terminating in many cases in collapse and death within twenty-four or forty-eight hours after its commencement. Should hydrecephaloid symptoms set in, the end may be delayed for a day or two longer. In the few cases which go on to recovery, cessation of vomiting appears to be one of the earliest symptoms of improvement; gradually the character of the stools alters, and they become more faecal; the restlessness abates, and improvement may be noted in the pulse and general appearance of the infant. Convalescence, however, is always tardy, and relapses are not uncommon.

Diagnosis.—The character of the onset, the persistent vomiting, the profuse serous dejections, the high temperature, and the symptoms of profound collapse rapidly developing within a few hours, form a picture unlikely to be mistaken for any other condition.

The odor of the stools makes it possible to determine two general classes of fermentation. The fermentation of the carbohydrate foods leads to the development of acids and gases, but under no circumstances to products with a putrid odor. Proteids yield either odorless or putrid products. Fitch (*Va. Med. Mthly.*, Mar., '94).

Etiology.—The exact nature of cholera infantum has not yet been proved, but analogy points strongly to its being a toxic condition produced by the absorption from the intestinal tract of some special toxin originating in fermenting or decomposing food. The prolonged heat of July and August appears to be a distinctly predisposing factor. Infants living under faulty hygienic conditions, and supplied either with an injudicious dietary or with milk food in the preparation of which due care has not been taken, appear to be among those most prone to attack. Although the disease may develop suddenly in the comparatively healthy, yet we find that, in the majority of cases, there has been a more or less severe antecedent disorder of the gastro-intestinal tract.

From 22 observations, the following conclusions are drawn: (1) the spores present in acute dyspepsia and introduced with the food will grow luxuriantly at the body-temperature, and these are capable of withstanding the action of the acids of the stomach; (2) since severe dyspepsias, especially of the cholera-infantum type, present the phenomena of acute intoxication, and increase in severity with the temperature of the atmosphere, their cause is to be sought in the poisons generated by the saprophytic germs of the stomach and intestines; (3) some of these cases have the general characteristics of acute infectious diseases in their etiology, but the majority are not particularly endemic or epidemic, and the special characteristics of infectious diseases (stage of incubation, typical course, etc.) are rare. Seifert (*Jahrbuch f. Kinderh. u. physische Erziehung*, B. 32, H. 4, '91).

1. When the heat rises above 165° F. the galactozymose, or starch-liquefying ferment, is destroyed. It is present in cows' milk only in minute quantities. 2. A portion of the lactalbumin is coagulated. 3. The casein, after the action of prolonged heat, is less readily coagulated by rennet, and yields slowly and imper-

fectly to the action of pepsin and pancreatin. 4. Fat is so affected by the heat that, after the milk has stood for some time, small lumps collect on the surface. 5. Milk-sugar is completely destroyed by prolonged heating. Leeds and Hiesland (*N. Y. Med. Jour.*, Nov. 7, '91).

Careful bacterial examinations of the stools in ninety-two different cases of various degrees of intensity, and in the fatal cases similar examinations of the intestinal contents and of the various internal organs, were coupled with histological examinations with a view to determining the relation of the intestinal infections and lesions to the remoter changes in the body. Conclusion that the intestinal disorders of children are to be attributed to no one specific form of bacteria. That in many cases the actual damage is done more by the products of the bacterial growth than by the germs themselves seems clear, since we know that these products are often strongly toxic, and since in many even fatal cases no penetration of the body-tissues by the bacteria can be demonstrated. In the milder forms of these disorders it is not unlikely that the acids, which Baginsky has shown are generated by the obligatory milk-fæces bacteria in moderate quantity even under normal conditions may be the irritant of the intestinal mucous membrane chiefly responsible for the symptoms; and this conception seems fully in accord with the decided acidity of the stools in these cases. In the severer cases, and particularly when pyogenic or necrotizing species of bacteria are present, distinct inflammatory changes in the intestinal mucosa are usually present and seem often to permit the entry of the bacteria to the underlying tissues, whence they may be disseminated throughout the body and induce a general pyæmic condition of which pneumonia is not an infrequent manifestation. Booker (*Johns Hopkins Hosp. Reports*, vol. vi, 159, '96).

The diarrhæal disorders of childhood occurring in conjunction with elevated summer temperature appear first as functional (chemical) disturbances and subsequently as profound organic lesions

of the intestinal wall. For the development of these conditions the ordinary saprophytic bacteria of the intestinal contents, and not specific bacteria, must be held responsible. The active organisms cause injury to the intestinal walls through the putrefactive processes of toxic character or through products usually non-toxic in character (ammonia and its derivatives), inasmuch as they act as inflammatory irritants; or they cause degeneration of the vegetative and the most important excretory organs (liver, kidneys, etc.) through the blood-stream and the lymph-stream. As a result of the interference with nutrition and the diminution in the resistance of the tissues thus brought about, the organism is exposed to the invasion of pathogenic bacteria of all kinds (staphylococci, streptococci, pneumococci, *oidium albicans*, etc.). There also results a predisposition to disease, as manifested by numerous complications. Baginsky (Berl. klin. Woch., Jan. 11, '97).

Study of thirteen cases leading to the following conclusions:—

1. The bacterium coli appears to be the pathogenic agent of the greater number of summer infantile diarrhæas.

2. This organism is the more often associated with the streptococcus pyogenes.

3. The virulence, more considerable than in the intestine of a healthy child, is almost always in direct relation to the condition of the child at the time the culture is taken, and does not appear to be proportional to the ulterior gravity of the case.

4. The mobility of the bacterium coli is, in general, proportional to its virulence. The jumping movement, nevertheless, does not correspond to an exalted virulence in comparison with the cases in which the mobility was very considerable without presenting these jumping movements.

5. The virulence of the bacterium coli found in the blood and other organs is identical to that of the bacterium coli taken from the intestine of the same individual. C. G. Cumston (Inter. Med. Jour., Mar., '97).

The toxic symptoms of gastro-intes-

tinal infection depend upon the introduction into the alimentary canal of poisonous substances which are contained in the food: tyrotoxicon, for instance, which originates in milk, and is poisonous for man and animals. Bacteria may be introduced from without; or the ordinary saprophytic bacteria which inhabit the intestinal canal may take on a special virulence. But the most severe disturbances are caused by the metabolism of bacteria; these micro-organisms by their activity either produce acids or cause decomposition of albuminoid substances; the products act as powerful irritants to the intestines, and by injuring the intestinal wall gain access to the blood and lymphatics, in this way producing the local and constitutional symptoms. A. Abt (Medicine, Feb., 1900).

Pathology.—There are very few changes found after death either in the intestinal canal or in any of the organs. The only lesion present may often be a desquamative catarrh of the gastro-intestinal tract. In those cases which develop hydrencephalic symptoms, the appearances found after death bear no proper relation to the gravity of the symptoms. The kidneys are generally found paler than usual, with a moderate cloudy swelling of the cortex, but not to a greater extent than may be present in other febrile disorders of infancy (Holt). The earlier symptoms may, therefore, reasonably be ascribed to the influence of some toxin upon the heart, nerve-centres, and vasomotor nerves of the intestines, while many of the later symptoms must be referred to the great abstraction of serous fluid from the body.

In cholera infantum a bacillus found which was colored after the method of Gram. Cultivated in gelatin or bouillon, an alkaline product is obtained, having a distinctive odor, which it retains many months. It is more resistant to external agents than the common bacillus, and more tenacious of life. Isolated, it is capable of producing experimental chol-

era, like several other microbes. It probably plays an important part in the production of cholera infantum, as proved by the following reasons: 1. It exists only in cases of cholera infantum, frequently in large numbers. 2. It produces experimental cholera. 3. It produces a substance apparently identical with that produced by the comma bacillus. In doses of 4 to 5 milligrammes ($\frac{3}{5}$ to $\frac{7}{10}$ grain) it is toxic, and causes the death of the animal. 4. It produces choleraic intestinal lesions. Lesage (*La Sem. Méd.*, Apr. 9, '90).

In spite of the most careful researches, no constant micro-organism has been found, the comma bacillus not being present. At times, when cholera infantum is prevalent the temperature of the child is often considerably above normal, especially toward the end of the day. It is supposed that the high temperature indirectly induces some changes favorable to the rapid growth of saprophytic germs already present. Alfred H. Carter (*Provincial Med. Jour.*, July, '93).

Study of the blood of three cases. The number of red cells is diminished; the total number of white cells is sometimes augmented and sometimes normal. The lymphocytes are always augmented; the mononuclears always diminished; the polynuclears and polymorphonuclears are sometimes augmented and sometimes normal. The eosinophiles are absent or normal. Nucleated red cells were observed twice. D'Orlandi (*Revue Men. des Mal. de l'Enfance*, July, '99).

Prognosis.—Few diseases have a worse prognosis. The higher the rectal temperature, the younger the infant, the hotter the weather, and the more unhygienic the surroundings, the more hopeless is the case. Rotch considers the disease to be, to some extent, self-limited, and thinks that, if the infant survive the first three days, a crisis comes and the prognosis improves.

Prognosis of cholera infantum is very unfavorable, especially when the child is artificially fed, and the mortality reaches very commonly 95 or 97 per cent. In

naturally-fed children the death-rate is low. In cases where the brain is early affected, with coma or convulsions present, the prognosis is bad. H. N. Potter (*Annals of Gynec. and Ped.*, Apr., '98).

Treatment.—Regarding the disorder as a toxic condition due to the absorption of a poison from the alimentary canal, our first efforts must be directed to clearing out this tract as promptly and thoroughly as possible. For this purpose a few grains of calomel combined with sodium bicarbonate should be given in divided doses. As soon as practicable, the stomach should be thoroughly washed out with a tepid weak solution of sodium bicarbonate ($\frac{1}{2}$ drachm to the pint). Following this the whole tract of the colon should be irrigated with a saline solution (1 drachm of sodium chloride to the pint). To insure passage of the solution into the higher portions of the colon, the hips of the infant must be well elevated, and the tube passed well up into the bowel, due attention being paid to its curve. The solution should be allowed to run into the gut in a gentle steady stream from a fountain-syringe placed at a height not exceeding two or three feet. Its passage upward may be favored by a gentle massage along the course of the bowel. The temperature of the irrigating fluid (from 85° F. to 105° F.) will be determined by the condition of the patient and the degree of pyrexia.

The use of antiseptic solutions for irrigating is, in our opinion, not to be recommended. To be in any degree effectual they must have a moderate strength, and then there is always danger of poisonous absorption. The irrigations should be repeated during the earlier hours of the attack. In the meantime, only stimulants and ice or iced water in small quantities should be allowed by the mouth. No form of nourishment

should be permitted during the first twenty-four hours. The digestive functions of the stomach and duodenum must be in complete abeyance, and any food administered will either be at once rejected by the stomach, increasing its hyperæmic condition, or, if retained, will go on to fermentation.

No food of any kind and no drugs given. Boiled water at the ordinary temperature, $3\frac{1}{2}$ ounces every hour for at least twenty-four hours and hypodermic injections of $1\frac{1}{2}$ to 6 drachms, according to age, every five hours, of a solution of:—

R Sterilized (not distilled) water, 10 ounces.

Common salt, 37 grains.

Citrate or benzoate of caffeine, 12 grains.—M.

These injections should be given slowly. In addition, warm baths (95° F.) twice or four times in the twenty-four hours should be given, each bath lasting from five to ten minutes. Washing out the stomach and intestines, though useful in other forms of infantile diarrhœa, may give rise in choleraic diarrhœa to convulsions or collapse. In convalescence, if the diarrhœa persists, calomel or subnitrate of bismuth may be given. Not any satisfactory results obtained with salol, betol, benzonaphthol, lactic acid, tannin, or opium. Marfan (*La Méd. Moderne*, June 15, '97).

To counteract the depressing action of the poison, and to prevent the paretic condition of the intestinal vasomotor system, an hypodermic injection of morphine combined with atropine is probably our best remedy. Holt recommends for an infant 1 year old an initial dose of not more than $\frac{1}{100}$ grain of morphine and $\frac{1}{800}$ grain of atropine. This may be repeated in an hour, if the desired sedative action is not obtained.

[Opium is used by a majority of writers, and, when administered rationally, is an agent of the greatest value. It should not be used until decomposing matter has been removed from the ali-

mentary canal. When the passages are small, infrequent, and of bad odor, it is decidedly contra-indicated, and it should not be pushed to narcotism in any case. It should never be combined with the ordinary diarrhœal mixtures, which are usually given at short intervals, but should be administered alone, and at intervals varying with the symptoms. HOLT and CRANDALL, Assoc. Eds., *Annual*, '92.]

Infants bear atropine wonderfully well. Almost adult doses of atropine given to children only a few months old; for instance, $\frac{1}{80}$ grain of morphine and $\frac{1}{150}$ grain of atropine, repeated two to four times in twenty-four hours. This controls the phenomena of cholera infantum, which would terminate life perhaps in a few hours without such treatment. William Bailey (*Amer. Pract. and News*, July 1, '93).

There is no drug comparable to small doses of atropine for controlling the depression and purging of cholera infantum. Cecil (*Amer. Pract. and News*, June 15, '98).

Morphine, it should be remembered, is contra-indicated in condition of drowsiness or stupor. Strychnine hypodermically will also prove of some service as a cardiac and respiratory stimulant. The effect of these remedies must be watched and the injections repeated as may be necessary to secure the desired action. It is better to avoid giving powerful drugs by the mouth, as doubt must exist as to the rapidity and extent of their absorption.

In threatening cases of heart-failure strong coffee, hot or iced, recommended, according to circumstances; or the injection into the bowel through a long flexible tube of hot water with some alcohol, and 1 or more drops of tincture of opium. Jacobi (*Pediatrics*, July, '96).

The main indications are flushing of the colon, and use of tepid baths, and will cause the temperature to fall and the symptoms to abate. Two or three douches may be required daily. Small doses of opium—not to check the diarrhœa, but to allay nervous symptoms—

may be given in the early stages. The following prescriptions are of value:—

R Bismuth. subgallat., 29 to 36 grains.

Pulv. opii, $\frac{1}{2}$ grain.

Pepsini, 6 to 12 grains.

M. Div. in pulv. No. 12.

Sig.: One every four hours, alternating with the following:—

R Hydrarg. chloridi mitis, $\frac{1}{2}$ grain.

Cerii oxalat., 2 grains.

Sacch. alb., q. s.

M. Div. in pulv. No. 12.

Sig.: One every four hours.

No antiseptics. No food first twenty-four hours; only ice or iced water in small quantities and perhaps stimulants. Stengel (No. Car. Med. Jour., Apr. 20, '99).

For the pyrexia cool baths are demanded, and should be administered in all cases when the temperature rises over 103° F. The bath, at the outset, should have a temperature of 97° F. and should be gradually cooled by the addition of ice or iced water till a temperature of 85° is reached. The infant should remain in the bath from five to fifteen minutes, according to the effect produced; while in the bath brisk friction should be employed over the limbs and body generally. If baths are impracticable, the cold wet pack may be employed. An ice-bag or cold cloths should be kept applied to the head.

To counteract the effects of the drain of fluid from the tissues no method can compare with the injection into the cellular tissue of a sterilized saline solution (45 grains of sodium chloride to the pint of water). About $\frac{1}{2}$ pint or more of this solution may be injected at once into the subcutaneous tissue of the thigh, abdomen, or buttock; the injection may be repeated twice a day. Marked improvement in all the symptoms generally follows its employment. A suitable syringe can be easily made by attaching an

hypodermic needle to the nozzle of a Davidson syringe by means of a few inches of rubber tubing.

Saline solutions or artificial serum successfully used. The physiological salt solution, which seems to be absorbed most readily, and Hayem's serum preferred. The most practical method of introducing the fluid is subcutaneously into the lumbar or gluteal regions, antiseptic precautions being observed. The fluid forms a swelling beneath the skin, the disappearance of which can be accelerated by light massage. Marois (Revue Men. des Mal. de l'Enfance, Dec., '93).

In children of 6 weeks to 3 months old suffering from infantile cholera, subcutaneous injections of normal saline solution in doses of about 14 drachms, morning and evening, resorted to. After the first or second injection the frequency of the stools diminished, they began to regain their normal consistence and appearance, and in a few days the patients recovered. Loin (Sem. Méd., vol. clxxvi; Brit. Med. Jour., Nov. 20, '97).

Hydrencephaloid symptoms call for a free use of stimulants; but opium, in this condition, is better avoided.

During the course of the disease care must be given to insure all possible warmth for the extremities. Sinapisms over the stomach may be of occasional benefit.

There is a growing tendency on the part of clinicians to consider even pure sterilized milk as a source of danger, owing to the properties which it manifests as a culture-medium. French observers are especially averse to its use, particularly in the acute stage. St. Philippe states that its suppression from the dietary often proves curative.

Meat- and vegetable- broths given in small doses very frequently repeated are kept down when milk will at once be ejected. White of egg beaten up in cool water and sweetened with sugar of milk to precede the administration of broths recommended. Sterile water should be given *ad libitum*. Fitch (Med. Times, Sept., 1900).

(See also CHOLERA MORBUS; INFANTS, DIARRHEAL DISORDERS OF; and NURSING AND ARTIFICIAL FEEDING.)

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CHOLERA MORBUS.

Synonyms.—Cholera nostras, sporadic cholera, summer diarrhoea, choleraic diarrhoea.

Definition.—An acute affection chiefly involving the stomach and intestines and characterized by copious diarrhoea and vomiting, first of the ordinary contents and afterward of serous fluid, accompanied by abdominal pains and rapidly-increasing prostration. It was recognized and clinically described with accuracy at an early period in medical history, under the names of sporadic and endemic cholera. It frequently occurs in children and is frequently mistaken for cholera infantum *per se*, now regarded by pediatricians as a separate disorder.

Symptoms.—Cholera morbus is liable to occur at all periods of life, though much more frequently during infancy and early childhood than during adult age. For convenience of clinical description, we may divide the cases met with at the bedside into two groups. In those belonging to the first group the patient is attacked suddenly with copious vomiting and purging, repeated at short intervals. The first discharges contain the ordinary contents of the stomach and bowels; the second are generally stained with the coloring matter of bile, while the subsequent stools consist of little else than large quantities of simple serous or "rice-water" fluid. The countenance soon becomes pale; the eyes sunken; the extremities cold and shrunk; the pulse small, frequent, and feeble; the urine scanty and sometimes suppressed. Fre-

quent pains in the abdomen or cramps in the muscles of the extremities cause paroxysms of great suffering. The mouth is dry and the thirst sometimes marked; the voice may be husky or feeble and the mind dull and inactive.

In the most severe cases the foregoing symptoms develop with such rapidity and severity that a fatal collapse is reached in less than twenty-four hours. In much the larger number of cases, however, after the first few hours the discharges become less frequent and profuse; the paroxysms of restlessness diminish; the pulse is less frequent, and at the end of twenty-four hours all the more active symptoms have ceased, and the secretions from the kidneys and salivary glands have returned to a more natural standard. The patient remains pale, languid, and weak for several days, during which much care is required in the regulation of diet, drink, and exercise to avoid a relapse.

In the second group of cases the symptoms commence less suddenly and are generally more persistent in duration. They quite uniformly begin with diarrhoeal discharges, soon becoming copious and watery or semifluid, frothy, and sometimes very offensive, with free vomiting as often as either drinks or nourishment accumulate in the stomach. In from four to six days the patient becomes so much exhausted as to exhibit all the symptoms of approaching collapse described in cases of the first group. Except in children under two years of age, in whom there may be, as in cholera infantum, collapse and death during the first or second week of their progress, the symptoms dominate in intensity, about the end of the first week, and the vomiting ceases or recurs only when the stomach is allowed to become too full of fluids. The intestinal discharges become

less frequent, smaller in quantity, and mixed with some mucus and portions of whatever had been taken for nourishment. At the same stage of progress a moderate grade of febrile reaction takes place, causing the palms of the hands and surface of the abdomen to become dry and warm; the tongue and mouth are very dry; and the patient, if a child, is more peevish and restless. The appearance and quality of the intestinal discharges vary much in different cases, being sometimes like turbid water, at other times green or light yellow with little or no odor, and in other cases semifluid and very offensive. The urine continues scanty and sometimes irritates the urethra in passing; the emaciation continues, and in many young children it becomes so extreme as to cause death from asthenia in from one to three months. But, in nearly all of the adults and many of the children, after the disease has continued from one to four weeks the discharges begin to improve both in quality and frequency, digestion and nutrition increase, and in a few weeks more the patients have regained a fair degree of health.

Differential Diagnosis.—The diseases and morbid conditions which are most likely to be mistaken for cholera morbus, both in children and adults, are epidemic cholera, and the effects of direct irritants, such as toxic doses of arsenic, poisonous mushrooms, overripe fruits, and the ptomaines occasionally in ice-cream, cheese, and canned meats, and gastro-enteric inflammation. The clinical phenomena presented by severe cases of cholera morbus and of cholera Asiatica are so nearly identical that a reliable diagnosis cannot be founded on these phenomena alone. It is true that a very large proportion of the cases of epidemic cholera commence with painless, watery

diarrhœal discharges continuing from one to three or more days, before the violent paroxysms of vomiting, purging, and cramps begin. When cholera morbus commences with diarrhœa the discharges are accompanied by more ordinary griping or abdominal pains and the early passages are more mixed with the ingesta and appearances of bile. In doubtful cases the discovery of the cholera bacillus of Koch in the intestinal discharges is claimed to be the only reliable proof that the case is one of true epidemic cholera. But there is so close a resemblance between the common bacillus of Koch and that found by Prior and Finkler in the discharges of ordinary cholera morbus as seen under the microscope, that cultures are required to complete the distinction between them. Cases of sudden and severe vomiting and purging caused by irritating ingesta are more readily distinguished from cholera morbus by their commencing very soon after the taking of bad food or poisonous substances, and by the existence of more constant burning sensations or distress at the epigastrium. The discharges also early show intermixture of mucus and sometimes streaks of blood, which, in cholera morbus, seldom appear until in the advanced stage of the disease. In gastro-enteritis the gastric and intestinal discharges are, from the beginning, less copious and are mixed with mucus; there is more epigastric distress, more febrile heat, and more frequent efforts to vomit, with the ejection of only small quantities of mucus of a green or yellow color.

In the advanced stage of some of the more severe cases of cholera morbus a condition of morbid vigilance, with rolling of the head, tossing of the hands, and moaning, supervened and sometimes

ended in a general convulsion. These symptoms have generally caused the friends, and sometimes the attending physician, to think that disease was developing in the brain. I have seen a few of such cases treated with cold applications to the head and blisters behind the ears, while the real cause of the symptoms was cerebral anæmia or exhaustion.

Microscopical examinations have shown the presence of a variety of micro-organisms in the discharges of cholera morbus, but no one of them has yet proved to be of diagnostic value.

Etiology.—Abundant clinical observations and vital statistics have shown that cholera morbus, both in children and in adults, prevails most in those parts of the temperate zone characterized by a wide range of temperature between the coldest days of winter and the hottest days of summer. Its prevalence is limited almost wholly to the months of June, July, August, and September, generally commencing with the first prostrated wave of high temperature during the last week in June or the first in July and reaching its greatest prevalence by the middle of the latter month. Thus, of the 1119 deaths from cholera morbus and cholera infantum in Chicago in 1896, 1 was reported in January, 2 in April, 2 in May, 180 in June, 485 in July, 339 in August, 108 in September, 1 in October, and 1 in December. In 1895 the whole number of deaths from the same disease was 1345, of which 6 were reported in March, 3 in May, 187 in June, 554 in July, 315 in August, 275 in September, 2 in October, 2 in November, and 1 in December. So great a mortality occurring regularly during the hottest months of each year induced me to make the subject a special study during the decade following 1870. The

facts gathered by such study justified the conclusion that cholera morbus, in both adults and children, commences uniformly during the first period of high summer temperature continuing day and night not less than five days consecutively, and new cases appear during each similar hot period for sixty of ninety days. It is not simply high temperature for a single day, or for three or four days while the nights remain cool, but high temperature both day and night, four or five days in succession, that favors the development of the disease. If the air is stagnant from absence of wind, or overcrowding and narrow streets, as in populous cities, the number of attacks will be much increased. On the other hand, cities and towns so located that the nights are favored by cooler breezes from the sea suffer but little from ordinary choleraic attacks.

Nearly all the writers on general practice and on diseases of children mention high temperature and overcrowded and poorly ventilated dwellings as merely predisposing causes of the disease under consideration; while they enumerate, as direct exciting causes, the taking of improper food, as mixed salads, impure or changed milk, impure and confined air, and, in infants, the progress of dentition and the nursing of overworked, improperly fed, and unhealthy mothers or nurses.

That all these causes exist and occasionally directly excite attacks of cholera morbus in both children and adults there can be no doubt. But as they all exist in all large cities and populous districts, and at all seasons of the year, if they were the chief causes of the disease it should prevail at all seasons of the year instead of being confined to three or four of the hottest months, and it should prevail as much in cities so located as to

receive cool breezes during the summer nights as in those that do not. There is probably as much lack of ventilation and as much use of poor or adulterated milk and other articles of food during the winter as during the summer. And there are quite as many overworked and badly-fed mothers, and as many infants "cutting teeth," in the month of January as in July, yet, as stated above, during the years 1895 and 1896 in Chicago only 1 death was reported from cholera morbus and infantum in January and 1039 in July. Such results show unmistakably that high temperature, continued through several consecutive days and nights, constitutes the ruling factor in the causation of the disease under consideration. The higher the temperature of the atmosphere, the less amount of oxygen is contained in each cubic foot, and consequently less reaches the air-cells of the lungs at each breath and less is distributed to the tissues of the body in a given time. Hence the nervous and muscular structures become relaxed, the watery elements of the blood escape, the perspiration carrying with it the free salts of the blood, which still further diminishes its capacity for taking up oxygen from the air-cells of the lungs. If this condition of things is continued through several successive days and nights, the capillaries of the mucous membranes of the stomach and intestines relax, and allow the serous element of the blood to escape more freely than perspiration from the cutaneous surfaces, and choleraic discharges more or less profuse are the result. If the patient is confined in a close, ill-ventilated room, as is likely to be the case with young children, especially at night, the evil effects are much increased. And close investigation shows that the beginning of a large majority of the cases

occurs during the last half of the night or early in the morning.

Since the etiological study of pathological bacteria with their ptomaines and toxins has come to engross the attention of the profession, and especially since the discovery of the epidemic cholera bacillus by Koch, many writers have suggested that cholera morbus also depended for its essential cause on a specific bacillus or its toxins. But no such organism has as yet been identified as the essential cause.

Pathology.—The essential pathological conditions involved in cases of uncomplicated cholera morbus are a morbidly sensitive condition of the mucous membrane of the alimentary canal, a general impairment of the tonicity of tissues with deficient oxygenation of the blood, and so decided an impairment of the vasomotor nervous influence over the vessels of the mucous membranes of the stomach and intestines as to allow copious exudation of the serous elements of the blood. The exudation constituting the cholera discharges results from these conditions and has no necessary connection with any grade of inflammation, catarrhal or otherwise. This is proved by the fact that, in the most rapidly fatal cases, post-mortem examinations revealed no ordinary traces of inflammation in the mucous membranes. It is only in the cases that run a more protracted course in which febrile reaction occurs, followed by more or less mucous discharges, that we find appearances of ordinary catarrhal inflammation.

Prognosis.—Cholera morbus, as it occurs in adults and in children over five years of age, runs a brief course and generally ends in recovery. Only a small percentage of such cases terminate fatally. It is very different, however, when the disease attacks infants or chil-

dren under three years of age. Only a small percentage of this mortality results from the violence of the first stage and direct collapse. Much the larger part results from the occurrence of reaction and the establishment of a persistent grade enteritis and progressive exhaustion and emaciation.

Treatment.—In the beginning of attacks of active cholera morbus the leading objects to be gained by treatment are to allay the morbid sensitiveness of the mucous membrane of the alimentary canal; to restore the general tonicity of the tissues and of the vasomotor nervous system; to promote the natural secretions, especially of the liver and kidneys; and to properly regulate the diet, drinks, and general sanitary surroundings of the patient. In the treatment of all this class of patients it is of the greatest importance to secure for them a constant supply of fresh, pure air. The most complete ventilation possible and rigid cleanliness should be enforced day and night. To accomplish this is often a very difficult task among all the classes of people who occupy small or overcrowded lodging-rooms on the narrower and less-cleanly streets of our large cities. But a firm insistence upon keeping whatever doors and windows there are freely open during hot summer nights as well as during the day, and the prompt removal of all gastric and intestinal discharges from the room, will accomplish much in this direction. To overcome the morbid sensitiveness of the mucous membrane, restore the tonicity of the nervous and vascular systems, and increase natural secretions, we need the combined or coincident use of anodynes, antiseptics, and tonics. In the early stage of active vomiting and diarrhoea the following formula has been used with the most satisfactory results:—

R Carbolic acid, $7\frac{1}{2}$ grains.

Glycerin, 5 drachms.

Camphorated tincture of opium, 2 ounces.

Cinnamon-water, $2\frac{1}{2}$ ounces.—M.

To an adult one teaspoonful of this mixture is to be given immediately after each paroxysm of vomiting until the paroxysms cease to recur. Vomiting is never a continuous process, and if a dose of medicine is given as soon as possible after a paroxysm a few minutes will elapse before the patient can vomit, and thus some impression of the medicine is obtained. But if we follow the inclination of the patients and nurses and wait for the patient to “rest a little” and the stomach to become “settled,” we simply allow time enough for the stomach to regain ability to vomit with another supply of serous exudation, and now the dose of medicine is likely to be ejected as soon as swallowed. The teaspoonful of the mixture may be given in half a tablespoonful of water; and in treating young children the dose should be apportioned to the age of the child. In addition to the above, small doses of calomel may be given every half-hour or hour until the discharges become less watery and show some indications of the presence of bile. Sinapisms of mustard may be applied over the epigastrium and to the back over the spine, but should be allowed to remain only long enough to redden the skin without vesicating it.

As soon as vomiting has ceased and the intestinal discharges show evidence of hepatic secretion, it is generally only necessary to continue the formula recommended every two, three, or four hours until the diarrhoea also has ceased and the patient is inclined to sleep. In many cases no further use of the preparation is required, rest and a judicious regula-

tion of the diet for a few days being sufficient to restore the patient to health.

Sometimes, however, the patient's mouth remains dry, the pulse more frequent than natural, the palms of the hands and the surface of the abdomen warmer than natural, the urine scanty, and several diarrhoeal discharges each day accompanied by pain and restlessness. In such cases a continuance of the carbolic-acid formula, already given, with a few drops of nitrous ether added to each dose, and giving, for nourishment only, a thin gruel or porridge made of good milk and wheat-flour, or pure milk with a little fresh lime-water added, will often insure recovery.

A very great variety of other remedies have been used with more or less benefit, nearly all of them, however, combining anodyne, antiseptic, and astringent or tonic properties with strict regulations of diet. The use of potassium bromide in the cholera morbus of infants has recently been strongly recommended by M. L. Brown. Preparations of bismuth, generally given with small doses of codeine or other anodyne, have long been used with benefit in the protracted cases. In treating cases, especially in young children, much care should be exercised in giving opiates and astringents, lest they add to the tardiness of the kidneys in secreting urine, and thereby increase the danger of coma or convulsions. (See CHOLERA INFANTUM and INFANTILE DIARRHŒA.)

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CHOLERA NOSTRAS. See CHOLERA ASIATICA and CHOLERA MORBUS.

CHOLURIA.

Definition.—Choluria is a morbid condition of the urine observed in jaundice and characterized by the presence in it

of the constituents of the gall, especially the bile-pigments and the bile-acids.

In urobilinuria the normal constituents of the bile are not found in the urine, but a derivative of the bile-pigments—the urobilin—is found instead.

Symptoms.—Although the bile-acids are ordinarily present in the urine in choluria, they do not occasion characteristic symptoms, and can only be revealed by special tests. The presence of the bile is more easily detected.

The urine containing bilirubin exhibits a color varying from a light saffron-yellow to one resembling mahogany or porter; even when the color is dark brown or almost black the urine will show a tinge of olive-green or green-brown when it is seen in thin strata. The color of the urine may resemble that of a very concentrated urine or of urine containing blood; in the later cases the froth of the urine is white, while the froth of the icteric urine is yellow and tinges white a piece of linen or blotting-paper dipped into it.

On standing, icteric urine ordinarily becomes greenish, because the bilirubin, by oxidizing, changes into biliverdin; by further decomposition of the urine the pigments are further changed into biliprasin and bilifuscin.

Although cholesterin is a normal constituent of the bile, it is not found in the urine in choluria, but in other morbid conditions of the urine: *e.g.*, chyluria.

In some cases of choluria renal cast observed in the urine without albuminuria. Nothnagel (Deut. Archiv f. klin. Med., xiii, p. 487).

Diagnosis.—Different remedies may give the urine a color resembling that observed in choluria. When santolin, thallin, rhubarb, or picric acid have been ingested, the urine and its froth will present a yellow color. In poisoning with the fruit of *Cytissus laburnum* a dark-

green color of the urine is observed, whereas it is blue-green after the ingestion of methylene-blue. The presence of the bile-pigments are revealed by different tests.

1. *Gmelin's test* consists in bringing strong nitric acid containing some nitrous acid in contact with the urine; if bile be present, a play of color is developed from green to blue, violet, and finally red. These changes are due to the gradual oxidation of the bile-pigments. The green color is the most characteristic, being dependent on the formation of biliverdin. It must be remembered that in most urines a reddish tint is brought out by nitric acid, while, if much indican is present, a blue or violet color may be developed.

Gmelin's test is best performed by pouring a few cubic centimetres of nitric acid in a test-tube or a conical glass; the urine is then allowed to flow gently so as to cause it to fall on the surface of the acid. The play of color is then observed at the junction of the liquids. The urine may also be placed in the tube first and the acid poured in gradually so that it sinks down to the bottom. Only the green color is evidence for the presence of bile-pigment, since the other colors may be due to the action of the acid upon the normal urine-pigments. The presence of albumin is of no consequence; the green color is even more visible against the white albuminous deposit. Gmelin's test has been modified in different ways.

Rosenbach proposes to filter the urine through white blotting-paper and place a drop of nitric acid on the filter while still moist; or a drop of the urine and of the acid are placed separately on a white porcelain surface and allowed to come in contact. In both cases the characteristic color-rings will appear.

Gmelin's test is very reliable when the quantity of bile-pigments is not too small; when this is the case, however, it is necessary to isolate the pigment by gently shaking the urine with chloroform; this agent will dissolve the bilirubin and cause a yellow color. When the test-tube is left quiet for some minutes the chloroform solution of bilirubin will sink to the bottom, the urine can be poured out, and the test performed with the chloroform solution. Indican is not dissolved by chloroform.

Different oxidizing substances have been used instead of nitric acid.

2. *The iodine test* (Smith-Maréchal): When a few drops of tincture of iodine are added to urine containing bile-pigment an emerald-green color will appear. A watery solution of bromine will produce a similar effect.

3. *Huppert's test*: A solution of ammonia and chloride of calcium is added to the urine. When bilirubin is present a deposit of bilirubin-chalk will be formed, which is filtered and washed down in a test-tube together with strong alcohol containing sulphuric acid. When boiled the liquid takes a blue-green or emerald-green color.

4. *Jolles* recommends the following method: To 50 cubic centimetres of urine, a drop of hydrochloric acid, chloride of barium in excess, and 5 cubic centimetres of chloroform are added. The mixture is shaken and left standing for 10 minutes, then poured out and the chloroform heated in a water-bath; 3 drops of sulphuretted sulphuric acid containing one-fourth of its volume of fuming sulphuric acid are added. The characteristic rings are found at the bottom of the tube.

5. When only bilirubin is to be revealed the sulpho-diazo-benzol test of Ehrlich may be of use. The reagent and

diluted acetic acid are added to the urine. When the mixture becomes dark, a few drops of glacial acetic acid will bring out the characteristic violet color.

Modification of Ehrlich's test: Three reagents are employed: (1) a 1-per-cent. watery solution of sulphanilic acid, (2) a 1-per-cent. watery solution of nitrite of soda, and (3) pure concentrated hydrochloric acid.

In a test-tube a few drops of the first and second agents are mixed with as much urine; a drop of hydrochloric acid is added and the mixture shaken. It will then, when bilirubin, even if a very small amount, is present, get dark violet. When the liquid is mixed with water the color changes into amethyst-violet. When only a very small quantity of bilirubin is present, the violet color will appear after a few minutes.

This test regarded as the most reliable and delicate of all. Krokiewicz and Batko (*Wiener med. Woch.*, Feb. 24, '98).

The biliary pigments in the urine may decompose by standing, and then the above-mentioned tests will be without result. Bilifuscin, which is formed by decomposition of the bilirubin, is revealed by moistening white blotting-paper with the urine; the paper will assume a brown color.

Urobilin is dissolved by chloroform, and the solution takes a greenish fluorescent color upon the addition of iodine and caustic potash. Von Jaksch recommends the test of Huppert: when urobilin is present the deposit is red-brown and becomes brown or gray-brown by boiling with sulphuric acid.

Pettenkofer's test: The bile-acids are detected by means of this test, which depends on the development of a deep-purple color when these acids are acted upon by cane-sugar and strong sulphuric acid. This reaction is, however, for several reasons, most unreliable when applied to urine, and the bile-acids must be separated from the urine by a compli-

cated method before the original Pettenkofer test can be made.

Strassburger, therefore, has modified the test in the following manner: Cane-sugar is added to the urine, and the solution is filtered through white filtering-paper. After drying the filter a drop of strong sulphuric acid is placed upon it, and after one-half minute a beautiful-red color will appear if bile-acid be present; the color finally changes into a dark purple.

Physiological test for bile in the urine depending upon the fact that the bile-salts precipitate the peptones from solution. The precipitate produced by urine containing bile-salts in a peptone solution acidulated with acetic acid is soluble in acetic or citric acid, thus differing from all other precipitates in the urine produced by acidulated reagents. Further, the precipitate may only be partially cleared up by heat. Quantitative application of the same principle may also be made. George Oliver ("*Bedside Urine-testing*," '89).

Etiology and Pathology.—Choluria takes place when the constituents of the bile are absorbed by the lymphatics and pass into the blood-vessels, from where they are excreted by the kidneys. It is, therefore, a constant symptom of jaundice, and is often observed before either the skin or the mucous membranes get stained with bile-pigment. The conditions which give rise to icterus will be discussed elsewhere, but by the examination of the urine it will never be possible to discover the origin of the jaundice. In some cases the pigment contained in the urine does not seem to be due to absorption of bile in the liver, but to have been formed directly by decomposition of the blood-pigments, either while circulating in the blood (*hæmatogen icterus*) or after the blood has been extravasated in the tissues (*Quincke's inogen icterus*).

Prognosis and Treatment.—As choluria is only a symptom of absorption of bile by the blood, its prognosis is in close relation to that of the disease acting as cause. Even if the choluria is very considerable, it will quickly disappear when the obstacles for the regular flow of the bile are removed. The treatment must also be directed against the fundamental disease, while the symptom, choluria, needs no special treatment.

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CHORDEE. See URINARY SYSTEM, SURGICAL DISEASES OF; GONORRHEA.

CHORDITIS VOCALIS. See LARYNGITIS.

CHOREA.—From the Greek: *χορεία*.
Synonym.—St. Vitus's dance.

Some confusion arises from the fact that under the name "chorea" are included several forms of nervous disease and degeneracy having as their common and characteristic symptom jerky, arhythmic, involuntary, inco-ordinate, muscular movements, while differing widely from one another in nature, causation, pathology, prognosis, and general symptomatology. This confusion is further added to by the varying opinions held by those who write upon the subject as to what conditions shall and what shall not be included among the choreas.

The following forms are described:—

1. Sydenham's chorea. With several varieties, as "chorea insaniens," "hemi-chorea," etc.
2. Endemic chorea.
3. Electric chorea.
4. Hysterical chorea.
5. Saltatory spasm.
6. Oscillatory spasm.
7. *Tic co-ordiné*, or "habit spasm."
8. Post-hemiplegic chorea.

9. Chronic adult chorea.

10. Huntington's chorea.

Of these, the first in order is the common St. Vitus's dance, chorea minor, or acute curable chorea, and much the most common and important of the choreoid diseases. It is the form meant when the word chorea is used without qualification. Those included from the second to the seventh belong to the functional neuroses, and may be regarded as expressions of neurodegeneracy. The eighth, ninth, and tenth are attended by degenerative changes in the cortex cerebri or spinal cord, or both.

Sydenham's Chorea.

Definition.—This is the well-known "St. Vitus's dance," an acquired functional neurosis, occurring during the middle and later periods of childhood, being rarely seen before the age of five years and after puberty; it is more common in females than in males, is more frequently met with in urban than in rural populations, and during the spring months.

Symptoms.—The onset of the disease is often foreshadowed by symptoms covering a prodromal period of a few days to a few weeks. These premonitory symptoms consist in general nervousness, a tendency to fidget and uneasiness, a change in disposition; irritability and emotional weakness, headache, vague pains, some impairment of general health, and possibly the occurrence of some one of the acute diseases or unfavorable circumstances enumerated below as exciting causes of the disorder. The disease always develops gradually and with varying rapidity in different cases, the onset being marked by the appearance of the characteristic choreic movements. These are peculiar, jerky, often lightning-like, clonic spasms, involving the muscles of the face and head, neck,

trunk, and extremities, usually more pronounced in the face and arms, and often more pronounced in one lateral half of the body ("hemichorea," when typically shown). The movements are sudden in onset and as suddenly cease; they are irregular in force and direction, markedly inco-ordinate, and differ in character from any other form of abnormal motor discharge known. They result in sudden grimaces and facial twitchings; sudden closure and opening of the eyes or mouth; sudden seizure and immediate dropping of any object it is attempted to grasp; twisting movements of the arms; peculiar dancing and bobbing movements of the feet, all of these movements seeming at times semipurposeful, leading to the idea on the part of the onlooker that they are due to bad habit or awkwardness, and could be prevented.

The movements vary in intensity from slight, scarcely-noticeable twitchings of co-ordinate groups of muscles, occurring at intervals, to violent and almost continuous clonic spasmodic contractions of nearly or quite all of the voluntary muscles of the body, resulting in writhings and contortions which completely incapacitate the patient and render necessary confinement to bed. The movements may occur when the muscles are at rest, but they are often precipitated or intensified by voluntary muscular effort of any kind. They are increased by efforts to prevent them and by anything which directs attention to them. They cease entirely during sleep. In many cases speech is affected in consequence of implication of labial muscles and tongue, giving rise to peculiar jerking out of words, explosive utterances, hesitation, or indistinctness of articulation which may in some cases amount to entire inability to talk. The lips are occasionally bitten; the tongue rarely. The

muscles of respiration may become involved, in which event there will be uneven, irregular respiratory movements, with, possibly, sighing, moaning, or other involuntary inarticulate sounds. Deglutition in severe cases is also more or less interfered with, and the patient naturally finds difficulty in feeding himself, on account of the inco-ordinate action of the muscles of the arms and hands. The urine and fæces may pass involuntarily. The gait is, in all well-marked cases, altered, and is usually shuffling and slow, the steps being unequal in length and in time, with difficulty in progressing in a straight line.

There is no rigidity nor tonic spasm. The muscles may become tender to pressure. There is usually some muscular weakness or paresis, which, in occasional cases, becomes extreme ("paralytic chorea"). The tendon-reflexes are normal. Trophic disorders are not the rule, but erythema, herpes zoster, or chloasmic blotches may be occasionally seen.

The movements are rarely general at first. They begin in the upper extremity, or the face, or, rarely, in the lower extremity. They spread over the corresponding half of the body, and finally attack the opposite side. In 144 cases studied, the onset was general in 25 cases only and hemilateral in 111 cases. G. Oddo (*Revue de Méd.*, Jan. 10, 1901).

There is always some disorder, usually a general dulling of tactile temperature and muscular sense. In the early stages pain is frequent, but in later stages this gives place to well-marked analgesia. Prickling, formication, and other paræsthesiæ are common.

In uncomplicated cases the pupillary reactions are normal.

Psychical abnormalities are the rule. These vary from the slight irritability, weakness, and altered disposition com-

monly seen in early stages to marked intellectual impairment with loss of memory, confusion of ideas, inability to concentrate attention, and grave emotional disorder of a melancholic cast. Occasionally a generalized outburst of acute insanity or delirium will occur, giving rise to the clinical subdivision "chorea insaniens."

Chorea an infectious disease. Like all other infectious diseases, its toxic principle may give rise to insanity with hallucinations, modified in form according to individual peculiarities. The onset of the insanity is, like all insanities of toxic origin, sudden, and its progress acute or subacute. Usually there is no parallelism between the choreic movements and the mental symptoms; but it is to be noted that, while chorea generally occurs in patients about 15 years of age, mental disturbance is generally found in choreic patients of 19 years of age. P. J. Möbius (*Münchener med. Woch.*, Dec. 20, 27, '92).

A true aphasia has been noted in a few instances, usually associated with a right hemichorea.

Along with the nervous symptoms above described in detail there are, in most cases, some evidences of disorder of the general bodily functions. Fever is present at some stage, usually early, in a majority of cases. When slight and maniacal chorea is present a temperature of 103° to 104° F. is often noted. A decided rise is usual in cases showing complications, such as rheumatism, pericarditis, or endocarditis.

The renal function is, in mild uncomplicated cases, normal. In the severe cases and in almost all febrile cases albuminuria exists, and the amount of urea excreted is in excess of the normal. In maniacal chorea there is, as a rule, a distinct nephritis.

Cardiac irregularity with abnormal rapidity of action is not infrequent, and

of all the complications of chorea, pericarditis and endocarditis are most often seen, the latter, especially, occurring, according to Osler, in quite one-half of all cases. Cardiac murmurs, due to the endocarditis and also in some instances to impoverished blood, are common. A true anæmia—diminution in hæmoglobin-percentage and in number of red and white corpuscles—is often noted.

In a limited number of cases symptoms of gastro-intestinal disorder occur, the symptoms being those shown in cases of autoinfection.

Since chorea occurs by preference in children of neurotic heredity, the psychological, physiological, and anatomical stigmata of degeneracy in greater or less prominence are often added to the symptoms above detailed.

Three grades of the disease are described: The mild, in which there is little disturbance of general health, no complications, and only moderately-well-marked choreic movements; the severe, in which fever, mental disorder, and other complications are present, and the inco-ordinate clonic spasms more severe and continuous, with well-pronounced muscular weakness; and the violent "chorea insaniens," characterized by rapid onset and progress, violent and continuous choreoid spasm, with fever and delirium, terminating not infrequently in death.

Motor symptoms in chorea arranged in five clinical groups: 1. Cases in which there is at some stage absence of the motions when at rest. 2. Cases in which the movements are less when the child is at rest, but are aggravated by voluntary movements. 3. Cases in which the severe choreiform movements disappear during voluntary movements. 4. Cases in which voluntary exertion does not influence the movements. 5. Cases presenting at different stages more than one of the above types. Weir Mitchell and

J. H. W. Rhein (Phila. Med. Jour., Jan. 22, '98).

Diagnosis.—In typical cases no great difficulties in diagnosis are presented, the characteristic muscular movements being, in themselves, sufficient to make the nature of the case plain. In atypical forms some doubt may arise, and there are a few other states which may be confounded with acute chorea. Thus, in hysteria choreiform movements suggesting chorea may take place ("hysterical chorea"). The anæsthesia and accompanying symptoms discoverable upon examination, together with the fact that in hysteria the movements are more rhythmical than in chorea, should make a diagnosis easy.

The muscular weakness may be so extreme as to suggest acute anterior poliomyelitis. The presence of the choreic movements are, however, enough to exclude poliomyelitis. Some forms of sclerosis and degenerative changes in the cerebral cortex are attended by choreiform movements, and may, when occurring in young persons, lead to thought of acute chorea. The presence of mental disorder, exaggerated reflexes, muscular rigidity, and other spastic symptoms should prevent mistake. Friedreich's ataxia was formerly and is still sometimes mistaken for chorea by those unfamiliar with the symptomatology of nervous diseases. The scanning speech, nystagmus, and the irregular, slow, and peculiar inco-ordinate movements of Friedreich's ataxia are sufficiently different from the clinical picture of chorea to prevent confusion if a proper examination is made.

Involuntary movement, muscular weakness, and muscular rigidity are three symptoms belonging to the group that depends on impaired functional integrity of the upper segment of the motor path. They are found in two

diseases which are due, not to structural, but to functional or, perhaps, rather nutritional changes in the cortex, viz.: paralysis agitans and chorea, which have a certain kinship to one another, the former being commonly hemiplegic in its mode of commencement and extension, while the other is frequently hemiplegic in its distribution throughout its entire course. In the case of chorea the abnormal movements are so obtrusive in comparison with the others that there is danger of the latter being overlooked, although weakness, at any rate, is now generally known as a frequent symptom. In exceptional instances weakness may be practically the only symptom, and the diagnosis may then be somewhat difficult. The age of the patient, the limitation of the weakness to one arm, and the occasional manifestation of slight choreic movements in the affected limb or in other parts may furnish the necessary clue. Monroe (Glasgow Med. Jour., Feb., '97).

Peculiarities of the knee-jerk. If, the patient being in the recumbent position, one raises the knee, allowing the heel to rest on the couch, making sure that all the muscles of the limbs are relaxed for the time being, and if one then tests the knee-jerk in the usual way, the foot is found to rise more or less smartly, but, instead of falling back immediately, it remains suspended for a variable time—hung up, as it were—and then slowly sinks back to its initial position. W. Gordon (Brit. Med. Jour., Mar. 30, 1901).

Etiology and Pathology.—In general terms, choreic movements of all kinds are primarily due to inherent neuronc weakness or instability, especially in motor sphere, with abnormally-developed motor association-tracts, or to defective insulation in lines of motor discharge.

An unstable condition of the higher nerve-centres predisposes to the condition, and a poison affecting these centres might produce in one person epilepsy, in another general neurasthenia, and in a third chorea. Bishop (Can. Pract., Nov., '97).

Chorea considered a condition of exhausted nerve-control. Upon this theory the association of chorea and rheumatism seems to be readily explained. As a result of the rheumatic poison there occurs a failure in the nutrition of the nerve-cells regulating and balancing muscular movements, and thus in certain individuals of neurotic tendency rheumatism becomes the causative factor of chorea. G. M. Swift (*Archives of Pediatrics*, Sept., '99).

The immediate exciting cause is irritation of cortical motor neurones from toxic substances in the blood due to infectious diseases, autointoxications, etc., nerve-cell fatigue, and in some cases temporarily induced abnormal "neuronic contacts" in sensorimotor sphere from sudden shock or emotion.

In the form of acute chorea under consideration the neurotic constitution with the anatomical and physiological stigma of degeneration can usually be traced. Anæmia with general bodily enfeeblement is common.

Study of 40 cases. The blood is rarely absolutely normal in amount of coloring matter and number of red corpuscles during an attack. There is usually a moderate diminution in the hæmoglobin and a relatively slighter decrease in the number of red corpuscles; in other words, the anæmia is chlorotic in type. There is no relation between the severity of the anæmia and that of the attack, and when the latter is profound there is usually some complication competent to explain it. Anæmia is not an immediate, direct, exciting cause, but frequently a predisposing one. Burr (*Pediatrics*, Feb. 1, '97).

Nearly all the cases show blood-changes and leucocytosis. In a few cases marked increase in the amoeboid movement of the white corpuscles observed and a possible diminution of the eosinophile or orthophiles among the white corpuscles. In all cases the condition of the blood is of great importance in establishing a prognosis. In the further study

of chorea its hæmatology is of the greatest importance, and the clinical aspects of the disease point to an infectious origin. Loudon (*Clin. Med. Rec.*, Dec., '97).

Two hundred cases of chorea analyzed. One hundred and thirty-six of the patients were females and 64 males. After 18 years, 3 cases were found among men and 10 among women. Thirty-seven cases occurred after the establishment of the menstrual function and 99 before. A neuropathic heredity and anomalies of the cranium play an undoubted rôle. This nervous heredity was clearly established in 73 cases, of which 49 were in females (with 9 cases of homologous heredity) and 24 in males (with 3 cases of homologous heredity). Anomalies of the cranium were very frequent, most often produced by rachitism, and belonging to an hydrocephalic type, more rarely to a submicrocephalic type, and more rarely still to a phagioccephalic type. Among other causes responsible for nervous predisposition are masturbation, acute diseases, concussion of the brain, and pregnancy. Exciting causes in a certain number of cases were articular rheumatism and infectious diseases, in others psychological traumatism. Influence of infectious maladies was manifest in 75 cases; in 58 of these there was acute articular rheumatism, with or without cardiac lesions. Of 75 post-infectious cases a nervous predisposition was present only in 50. In cases in which chorea developed after a psychological traumatism the rôle of neuropathic heredity was much more manifest. Of the 66 cases of this class such heredity existed in 64 patients. Psychological traumatism most often was of the nature of a fright. In 59 cases the exciting cause could not be ascertained. Kraft-Ebing (*Wiener klin. Woch.*, No. 43, '99).

The urine in Sydenham's chorea presents the following characteristics: Diminution of the daily quantity; specific gravity relatively high; total acidity increased; diminution during the disease of the quantity of nitrogen which is not eliminated as urea; increased elimination of uric acid; decrease in elimination of chlorides; increase of phosphates; total quantity of

sulphuric acid and allied substances, unchanged. De Marchis (*La Riforma Medica*, July 5, 1902).

Some cases develop without any discoverable exciting cause, but in most instances the onset of the chorea is preceded by mental strain, worry, or shock of some kind—overwork at school, fear, religious emotion, etc.—or by the occurrence of some infectious disease or toxæmic state, such as rheumatism.

Chorea is a symptom, and not a disease, the principal cause being rheumatism acting on a nervous subject. Duckworth (*Brooklyn Med. Jour.*, May, '92).

In 134 out of 196 cases of chorea rheumatism was present. In the majority of cases chorea is the result of rheumatic diathesis, although cases occur which must be considered as true neuroses. Sée (*La Méd. Mod.*, Oct. 15, 22, '91).

Study of the seasonal relations of chorea and rheumatism for a period of fifteen years. Chorea and rheumatism are periodical, the least severe attacks in chorea occurring in October and November and the most severe in March and April. It is the same in rheumatism. These two affections are considered to have the same causal relation with meteorological conditions. Morris Lewis (*Boston Med. and Surg. Jour.*, June 23, '92).

Chorea is nearly always secondary to acute articular rheumatism, or to some infectious disease. An efficient part is played by the mental emotions. In 19 of 76 cases there was no family history of disease, but an unobserved previous infection suspected. In 14 cases there were cardiac lesions, and in 6 of the 14 the chorea was unmistakably of rheumatic origin; further, there is an etiological identity between chorea and endocarditis. Marfan (*Revue Mens. des Mal. de l'Enf.*, Aug., '97).

Chorea is nothing else but one of the numerous manifestations of rheumatism, for the following reasons: It affects the same geographic distribution; like rheumatism, it is most frequent in cold countries; it shows its preference for damp

seasons; besides, if choreic patients are examined with care, it will be found that cardiac affections are frequent, even though they may not have had rheumatic antecedents. One of the arguments against a rheumatic origin is that the disease is not modified by sodium salicylate, but this same drug is equally ineffective as regards endocarditis, cutaneous eruptions, etc. Simon (*Med. Press and Circular*, Apr. 7, '97).

Histories of 1400 cases of chorea seen in Vanderbilt Clinic shows proportion of females affected compared with males was almost 2 to 1; the disease is more common in the poorer classes. Heredity and infectious diseases seemed to bear no definite relation to the disease, the most constant element being malnutrition. Fright immediately before onset was noted in 285 cases, and 290 had distinct history of true rheumatism. Organic heart-murmurs were present in 175 cases, functional in 123, and none in 871. Nine hundred and nineteen cases occurred between the ages of seven and fourteen years; of 1129 cases, 707 came on between March and August. Recurrences present in one-fourth of the cases, were most common in the spring. Choreic movements were general in 951 cases, unilateral in 449, the right side being affected slightly more than the left. Mental irritability was noted in 827 and speech was affected in 556. M. Allen Starr ("Abraham Jacobi Festschrift"; *Phila. Med. Jour.*, May 26, 1900).

The theory of the infective genesis of chorea (rheumatic) points out that a negative bacteriological result need not exclude micro-organisms as a cause, for this may result from several causes: for example, spontaneous attenuation of the micro-organisms, germicidal action of organic fluids, plasmolysis, irregular distribution of the bacilli, occlusion (inflammatory) of the communicating channel between the internal cavities of the brain and the perimedullary spaces, stratification of the bacilli in different layers of the fluid, or insufficiency of material taken for test purposes. Any one of these causes might account for a negative result in testing for bacilli.

and taken together they may explain the cases of rheumatic chorea where germs have not been discovered. And since every day seems to show more clearly an association between rheumatism and the various pyogenic organisms, it is these that one looks for in chorea. The non-rheumatic choreas may be due to germs not easily cultivated. Mircoli (*Gazz. degli Osped.*, Nov. 23, 1902).

Measles, whooping-cough, influenza, diphtheria, scarlet fever, endocarditis, malaria, urinary abnormalities, aggravated constipation, etc., are also important factors.

Query whether chorea should be considered a sequel of scarlet fever or not. Cheadle recognizes it as such, but qualifies the opinion by adding that, in 1894 and 1896, 8360 cases of scarlet fever were under treatment at the Northeastern Hospital, and of these 5355 were completed there. Thirteen cases of chorea were observed, or 1 in 412 completed cases. Osler found 1 case of chorea to every 180 patients. Hence it would appear that chorea is less frequent among scarlet-fever patients than among patients in general. Of Osler's 13 cases, 5 had rheumatic manifestations, which, in each instance, immediately preceded, or appeared simultaneously with, the chorea. Rheumatism or joint-affection which occurs as a complication of scarlet fever sets in toward the end of the first week; but in these cases it was considerably later, indicating a difference in the nature of the joint-affection. Priestley (*Brit. Med. Jour.*, Sept. 25, '97).

A case of paralysis and chorea as a sequel to scarlet fever. That the scarlatinal attack bore a causative relation to the growth of the nervous condition there can be no doubt. Cornell (*Medicine*, Jan., '98).

From a study of 239 cases of chorea gravidarum it was found that the chorea frequently appears in a patient who has suffered from the ordinary form on some previous occasion. Chorea gravidarum may come on gradually or suddenly, and in the latter case is not infrequently due

to a sudden fright or emotion. The onset of the chorea may be accompanied by globus and other symptoms. Many of these cases show extreme constipation. Mastier (*Thèse de Lyon*, '99).

In over 71 per cent. an infectious etiology could be obtained in chorea. Not only are endocarditis and articular rheumatism frequently mentioned in the past history, but often some catarrhal condition of the respiratory tract, as angina, bronchitis, laryngitis, or influenza, seems to be the precursor, alone or in various combinations. Of the non-infectious cases, the majority of patients possessed a neuropathic tendency and were considerably run down, through rapid growth, overexertion, or insufficient nourishment, and frequently showed the stigmata of a past rachitis or scrofulosis. Here the most frequently mentioned cause seemed to be fright, and often hysteria played an important part. G. Koster (*Münchener med. Wochen.*, Aug. 12, 1902).

Rheumatism is the most important etiological factor of chorea, the cardiac lesions being closely associated with it. Both the rheumatic diathesis and cardiac morbid conditions predispose to the disease.

Study of the relations existing between chorea, rheumatism, and diseases of the heart: 1. Neither rheumatism nor heart disease is essential to chorea. 2. The preponderance of evidence points toward the conclusion not only that rheumatism and organic heart disease conjointly appear more frequently in the choreic subject than can be accounted for by coincidence, but that the same is true of each of these affections separately. It follows, therefore, that rheumatism predisposes to chorea, and organic heart disease has the same tendency. 3. Fatal cases are generally associated with organic heart disease, and probably with organic disease of the central nervous system, notably cerebral embolism. 4. There is a large class of functional cases, mainly reflex and fostered by circumstances tending to produce functional symptoms in general. 5. The pathological connection be-

tween rheumatism and chorea, excepting in the cases where emboli are produced by accompanying endocarditis, is still obscure; probably no one theory is applicable to all cases. 6. The mechanism by which the peculiar phenomena of chorea are produced is unknown. Walton and Vickery (Amer. Jour. Med. Sci., May, '92).

Examination of 140 persons having suffered from chorea at least two years previously. In 51, heart normal; in 72, symptoms of organic lesion; in 17, cardiac disturbances. No rheumatic history in 66 per cent. Cause: an infection allied to rheumatism, but differing from it. Osler (Pacific Med. Jour., Aug., '95).

Six cases, all in young women of ages varying from 17 to 21, in which the disease was very grave, and proved fatal in two. The previous association of scarlatina or rheumatism—articular, endocardial, and præcordial—noted in every case; likewise recurrence of chorea on the same side as the former rheumatic affection had existed. Napier (Glasgow Med. Jour., Feb., '97).

Out of 20 choreic patients personally examined, in 7 there was a previous history of rheumatic fever in the patient; in 4 there was a strong family history of rheumatic fever, and in the remaining 9 there was no history of rheumatic fever, but, out of these 9, 2 had mitral stenosis, 5 had mitral regurgitation, and only 2 had no valvular affection of the heart. Out of the 20 cases, 5 gave a history of fright or shock. In the 20 cases 18 came on between the fourth and the fifteenth year, 5 of which occurred at the fourteenth or fifteenth year. This refers only to first attacks of chorea. Sixteen occurred in females and only 4 in males. Purves Stewart (Med. Brief, June, '98).

About 21 per cent. of all choreic cases give a rheumatic history, either in their parents or themselves prior to the disease. Choreia follows an attack of scarlet fever in children in about 25 per cent. of all cases. Forcing children at school is a most important factor in producing the disease. Ocular defects may lie at the bottom of some cases of chorea. Edwin Williams (Memphis Lancet, Aug., '99).

View that chorea is associated with rheumatism opposed. Of seventeen consecutive cases of chorea at personal clinic, only one had rheumatism before or during the attack, and of several who returned after recovery none had shown any sign of the latter disease. Gilles de la Tourette (Rev. Neurol., June 30, 1900).

Forty-seven cases of chorea minor studied. Age of patients varied from 3 to 16 years, and in 28 the disease had begun from seven to eleven years previously; 39 were girls and 8 boys. In 24 cases there was the family history of rheumatism or of psychical affections. Among the 47 there were 15 who had had rheumatic fever, either before or during the chorea, and in 16 chorea had begun or had been accompanied by febrile phenomena with angina, articular affections, or erythema nodosum. T. Frølich (Norsk Mag. f. Laegevidensk., Sept., 1900).

The frequency of fibrinous accretions upon the cardiac valves and the undisputed frequency of embolism of the cerebral arteries give origin to the often-mentioned "embolic theory" of the causation of chorea, a theory first advanced by Kirkes and supported especially by Hughlings-Jackson, according to which the inco-ordinate movements of chorea are due to multiple capillary embolism of the corpus striatum. This explanation is, however, somewhat far-fetched and it is also insufficient, since there are many cases of chorea which show no evidence of embolism and in which there is no endocarditis.

A specific microbic origin has been suggested, but is, as yet, not demonstrated.

Hints at the possibility of an infectious origin for chorea. Report of a case of *chorea insaniens* in a woman of 27, who had had two attacks of rheumatism, and, with the second, had had delirium and irregular movements of the limbs. The autopsy showed an acute endocarditis, abscess of the parotid, and catarrhal

pneumonia of both lungs. No special germ, however, could be discovered. Chorea is a general systemic affection, acting with greatest intensity upon the vascular system and the leptomeninges; its cause is to be sought for in a special bacillus. Berkley (Johns Hopkins Hosp. Rep., Aug., '91).

Autopsy of a case in which microscopical examination showed a conspicuous chronic leptomeningitis involving the vertex of the brain; a proliferating process, without exudation or much cell-infiltration. In the superficial layer of the cortex there was cellular infiltration with degenerative changes. At this point a diplococcus was found. The micro-organisms were observed only in the deep layer of the pia and the superficial part of the cortex. Dana (N. Y. Med. Jour., Aug. 19, '93).

Study of 600 cases. The toxin of chorea may be a glycoxin, for which reason micro-organisms will not be found in the blood. No light thrown upon the connection of arthritis and chorea nor any explanation advanced why the toxin settles in the brain when chorea occurs in rheumatic subjects. Failed to find any cases of rheumatism caused by fright or any of chorea primarily induced by chill. Churton (Med. News, Dec. 4, '97).

Study of choreics bacteriologically, and discovery of a lanceolate encapsulated diplococcus extremely pathogenic to guinea-pigs, in which it determines an hæmorrhagic hyperæmia with diminished fibrin and no œdema. The histological lesions in the nervous system of patients and in the viscera of the guinea-pigs showed that the effect was more toxic than septic, with an elective action on the vessels. The findings appear to sustain Leroux's theory that chorea is a syndrome determined by some infective or toxic agent on a soil prepared by an inheritance of neurotic and arthritic tendencies. Mei (Gaz. degli Osp. et delle Clin., Aug. 22, '97).

Conclusions regarding etiology of chorea are (1) rheumatic chorea is infective, and depends on the action of toxins of micro-organisms on the nervous system; (2) staphylococci are the chief source of infection, in that they have

been found twice as often as all the other organisms put together. Maragliano (Centralb. f. innere Med., xx, p. 489, '99).

While the importance of the pyogenic micro-organisms in relation to chorea is generally recognized, recent bacteriological examinations of the spinal fluid of choreic patients go to show that the relation is a closer one than is usually supposed. Staphylococci found in the cerebro-spinal fluid in two personal cases. In a third case of erysipelas, which was followed by chorea of a severe type, not only had lumbar puncture a favorable therapeutic effect on the movements and the sleeplessness, but also streptococci were demonstrated in the fluid. In both the blood and urine of this case streptococci were also found. The statistics of Triboulet show that a third of all chorea cases furnish a history of an antecedent febrile attack, of which the most common are scarlatina, measles, and erysipelas. In all cases of chorea the cerebro-spinal fluid should be examined. Fornaca (Riforma Medica, No. 74, 1901).

Chorea is not infrequently an infectious disease; it is, therefore, necessary to make a bacteriological examination of the blood in every case. Not rarely the disease is of streptococcic origin. In polyvalent antistreptococcic serum we possess a rational remedy for the treatment of appropriate cases of this disease. P. A. Preobrazhensky (Medicinskoje Obozrenije, vol. lviii, No. 21, 1902).

Other suggested causes are cerebral hyperæmia, capillary thrombosis, and prolonged arterial spasm; but none of these theories offer so rational an explanation of the observed symptoms as that which attributes the choreiform movements to inherent instability in sensorimotor sphere, together with a toxæmia or a shock sufficient to disarrange the customary association- or contact-areas in cortex, basal ganglia, and cord.

In mild cases, should death occur, it is likely that no characteristic nor well-

marked anatomical alterations would be detected. In severe cases there are changes in the neurone bodies of the cerebral cortex and lenticular nuclei paralleling those of fatigue, as described by Hodges and others, together with, in cases of long standing, distinct degenerative changes in nervous elements of the cortex, pyramidal tracts, and cord. When these degenerative alterations are well marked, it is likely that the clinical picture during life was that of chronic adult chorea, rather than Sydenham's chorea. In addition to the changes in the nervous elements themselves, there are, in severe and long-continued cases, secondary changes in the connective-tissue structures and blood-vessels, perivascular dilatation, accumulations of round cells in lymph-spaces, etc. In acute cases there are often small areas of softening, with congestion and capillary dilatation in cortex and lenticular nuclei. In maniacal chorea the cortex and pia mater are chiefly involved, there being usually intense hyperæmia, with evidences of acute inflammation. The changes resemble those of violent acute mania or delirium.

Report of thirty-nine autopsies. The chief changes were just beneath the cortex, where the white matter was honey-combed with little spaces, round or oval. These spaces were empty or partly filled with blood-vessels. The process, he believes, was non-inflammatory, and was due to abnormal dilatation and filtration of the vessels' contents. The same changes were found in the basal ganglia and the internal capsule, whose fibres were split up by interlaced and dilated vessels. There was also noticed a varicosity of the nerve-fibres. In the recorded cases the most marked changes were hyperæmia, periarterial exudations, erosions, softened spots, multiple hæmorrhages, and occasionally embolisms. The changes are most marked in the deeper parts of the motor tract; but he con-

siders chorea not as a local disease, but as a disease of the intracranial motor tract, including its starting-point in the cortex and especially in its co-ordinating adjuncts,—the lenticular nucleus and thalamus. Dana (*Brain*, Oct., '90).

An affection of cerebral cortex. Loss of control which sensitive areas possess over motor areas. Brush (*New York Med. Jour.*, Mar. 9, '95).

Case of a girl of 12, in whom chorea set in six weeks after a first attack of acute rheumatism and a fortnight after the first subjective signs of cardiac implication. Bronchitis, and eventually double pneumonia, supervened, and the patient died just a month after the commencement of the chorea. The necropsy was made four hours after death, which was found to be due to double pneumonia, with staphylococcal endocarditis and pericarditis. Multiple thrombi, colorless, red, mixed, and hyaline, were found in the central nervous system, particularly the cerebrum. There was a deposit of clotty masses in the adventitia, of a medium-sized vein in the globus pallidus, and of numerous fat-globules in and on the cerebral blood-vessels. There had been a considerable amount of sensory disturbance in the case, due probably to the multiple thromboses. The symptoms of chorea due to vasomotor disturbances in the brain as the result of the rheumatic toxæmia. The thromboses are the extreme expression of these changes. Okada (*Mitteil. der med. Facult. der kaiserl. Japan, Univ. zu Tokio*, 1902).

Prognosis.—The rule in chorea is a gradual and insidious onset, a slow rise in intensity and distinctness of symptoms, followed by a stationary period of weeks or several months, and a gradual subsidence of the disease, with final recovery. The malady is acute and quite curable, with a natural tendency to recovery, even when not treated at all. Some mild cases recover in a few weeks; two to three months is the duration of the typical forms, although occasionally

the symptoms may persist for six or more months. Some nervousness and slight twitchings noticed when the child is startled or excited may continue for months after recovery, and a species of chronic "habit chorea" may be the final result. A true chronic chorea rarely or never follows this variety of neurosis in children, but is occasionally seen after acute chorea in adults. In general, however, a chronic chorea in adults or in children is apt to be associated with degeneration of the cortical motor cells and pyramidal tracts, thus differing widely from the form of acute chorea under consideration. The milder forms of chorea are unattended by danger to life. Chorea insaniens is often fatal, and, where recovery from the acute affection occurs, there is danger of some permanent mental deterioration.

Relapses after apparent recovery are not rare. The existence of a complicating rheumatism or endocarditis is thought to favor relapse.

The result in any case of chorea is largely influenced by the complications and underlying cause.

Treatment and Prophylaxis.—In view of the frequency with which chorea develops in intelligent and ambitious children of neurotic heredity who are overworked at school, something may be done toward preventing the development of the disease by insisting upon moderation in study and a proper observance of the rules of physical and mental hygiene.

Competition for prizes and any other excess in school-work should be forbidden, and the child encouraged to spend as much time as possible out-of-doors, in healthy games and play. Dropping back a year in classes will, by diminishing amount of intellectual effort required, often prove of decided benefit,

not only for the time being, but in all after-life. An epidemic of chorea-like hysterical spasm was observed in a girls' school by Laquer.

Three cases of arrhythmic hysterical chorea in which the hysteria showed all the features of Sydenham's chorea, thus confirming the facts previously advanced by Debove, Merklen, Chantemesse, Jofroy, Séglas, Reque, and Perret. B. Ouché (*Le Progrès Méd.*, Dec. 5, '91).

Chorea never arises in healthy children from imitation, but in all cases of so-called epidemics we have to do with an hysterical affection. In weak and poorly-nourished children chorea is often developed in the schools from overwork. Köerner (*Deut. med. Woch.*, Apr. 2, '91).

The co-existence of chorea and hysteria admitted in a certain number of cases, but more often common chorea does not arise from hysteria, but hysteria is capable of simulating it. Dettling (*Thèse de Paris*, '92).

Mental disturbances appearing in chorea divided into groups: 1. Cases of degenerative disturbance the exacerbations of which are often accompanied by choreic or amulsiive anomalies of movement. 2. Lymphatic posthemiplegic chorea with distinct focal brain disease. 3. Imitative chorea or anomalous movements evoked primarily by psychical or traumatic indignity; these are mainly hysterical. 4. Cases of Huntington's chorea, which is analogous to paralytic dementia. 5. Senile chorea. 6. Sydenham's chorea, which may be characterized by elementary psychical disturbances, fleeting, light delirium, the symptoms of profound neurasthenia, stupor and dementia, or by complicating psychoses of the severest form. Von Krafft-Ebing (*Wiener klin. Rundschau*, July 29, 1900).

Should any indication of chorea appear, the child should be removed from school at once and placed in as good hygienic circumstances as possible. The child's attention should not be directed toward the disease, and the nervous manifestations should not be openly noticed nor commented upon by others, since

self-consciousness and suggestion play an important part in exaggerating the choreic symptoms. Removal of the patient from home, relatives, and familiar surroundings will go far toward relieving the condition. A trip to the country or to the sea-shore when possible is always beneficial. Massage and hydrotherapeutic measures are almost always indicated, and do especial good in the cases in which anæmia and general debility are present.

Hydrotherapy; wet pack best method, —sheet dipped in water at 50° to 54° F., then lightly wrung out, spread over mattress with oil-cloth; then closely wrapped around patient; latter rubbed from head to foot and placed with sheet in woolen blanket and returned to bed. Charyeux (*Revue de Thérapeutique Médico-Chir.*, Oct. 1, '95).

In severe cases rest in bed for a few days or even for weeks is advisable, and in the severest cases is made necessary by the violence of the contortions, which may entirely prevent the child from walking or standing. With these non-medicinal restorative measures the patient will usually recover within a month or two, but in most cases there can be little doubt that restoration is hastened by proper medicinal treatment. The drugs which experience has shown to be most useful are arsenic, strychnine, the zinc salts, silver nitrate, potassium iodide, and *cimicifuga*.

No routine treatment can be followed. The first indication is to remove everything that may be an irritating cause. The patient should be taken from school; if the prepuce is too long, it should be cut off; if there is evidence of worms they should be got rid of, etc. The percentage of hypermetropia, usually latent, he believes is extremely large, perhaps fully 70 per cent.; and an investigation for latent heterophoria should always be made with the greatest care and patience. The relief of marked heterophoria should

be finally attained only by graduated tenotomies upon the muscles exhibiting abnormal tension or by advancement of the tendons exhibiting defective power. Prismatic glasses are not curative and should not be given for constant use. Choreic subjects are usually rapidly cured by eye-treatment alone; the eye-problems encountered, however, are not, as a rule, so complicated and difficult to solve as those of epileptics. Sodium bromides employed with Fowler's solution of arsenic, and, if there is a chance of malaria being a factor in the trouble, quinine also. Tompkins (*Amer. Jour. Obst.*, Mar., '97).

Mental and physical rest and maximum doses of antipyrine and arsenic recommended in the same way as suggested by Grancher. Treatment completed by the use of some hypnotic, and during convalescence gymnastics and sulphur-baths prescribed. Marfan (*Revue Men. des Mal. de l'Enfance*, Aug., '97).

Sedatives are of value combined with arsenic, the latter being given in the form of Fowler's solution or as a solution of arsenous acid in doses which are rapidly raised to twice or even three times what is usually accepted as the maximum. At the same time sodium or potassium bromide and antipyrine are given in large doses, while the relationship between rheumatism, endocarditis, and chorea is a sufficient indication for the routine use of the salicylates in conjunction with the other remedies. W. von Bechterew (*Centralb. f. Nervenheilk. u. Psychiatrie*, Aug., 1900).

Study of 1400 cases of chorea. Arsenic, pushed to the physiological limit, and then reduced slightly, is the best drug in the treatment, and antipyrine is second; exalgin, phenacetin, bromide, chloral, and paraldehyde produced little effect. Better than any medicine is a change of air. M. Allen Starr (*"Jacobi Festschrift"*; *Phila. Med. Jour.*, May 26, 1900).

Several cases of neuritis which supervened after the cure of chorea by arsenic. In these cases 10 drops of liquor arsenicalis had been given thrice daily for three or four weeks, by which time the patients had taken an equivalent of from

6 to 8 grains of arsenous acid. None of the cases gave any warning of the advent of the neuritis during the administration of the arsenic, but the symptoms developed after an interval of from a week to a fortnight subsequent to its discontinuance. No dose amounting in the aggregate to more than 4 grains of arsenous acid should be administered to a child suffering from an attack of chorea. Railton (*Med. Chron.*, Feb., 1900).

Experiments performed in 1879 by Chapuis have shown that arsenic when combined with butter appears infinitely less toxic than when given in solution. These investigations, personally repeated, show that the amount of butter should be invariably fixed to 10 grammes whatever the quantity of active principle incorporated with it. To prepare the mixture a known quantity of arsenous acid is taken according to the dose to be administered. To this is added sodium chloride in such proportion that 0.1 gramme corresponds to 0.005 of arsenous acid. This mixture of sodium chloride and arsenic is triturated with 10 grammes of fresh butter, and this amount is given spread on bread: a form of medication which is extremely palatable to children. The drug must never be administered while fasting. The whole dose should be given at a time, but two doses a day seem to be sufficient. Under this method of treatment it is not necessary to confine the patient to bed or to put him on a milk diet. A more liberal diet gives better results. Lévy (*Thèse de Lyon*, 1900).

Three cases of chorea treated with sodium cacodylate instead of arsenic. The former drug given hypodermically, first in doses of $\frac{1}{3}$ grain, then of $\frac{2}{3}$ grain. The patients recovered in from one to three weeks. In all the ordinary treatment had previously been tried without benefit. Lannois (*Revue de Thérap. Méd. Chir.*, lxxviii, No. 5, 1901).

The treatment of chorea with arsenic is inadvisable in very acute cases with coma or paralyses, in those that have been treated for some time with small doses of arsenic, in those in which there is reason to suppose that the rheumatic process is going on in the acute

form, and in cases of advanced cardiac disease. The writer gives the following principles for the administration of arsenic in the treatment of chorea: See that the tongue is clear before commencing treatment, and, if not, give a mild mercurial purge and a stomachic mixture for forty-eight hours. Put the patient on a bland and easily digested diet. Give the drug in a much diluted form and in the same dilution throughout. Do not discontinue on the first attack of vomiting, which may be due to accidental causes. Increase the dose daily. Keep the patient in bed throughout the treatment. If the vomiting persists, discontinue the drug for twenty-four hours and then give the same dose as the last. Examine the patient very carefully daily for any sign of toxic action. What must be aimed at is a form of shock action on the nerve-tissues, and this may explain why long-continued treatment with small doses fails. On discontinuing the arsenic, the writer usually gives a mixture containing iron for a few days. F. M. Pope (*Brit. Med. Jour.*, Oct. 18, 1902).

It is always to be kept in mind that chorea is a symptom, in many instances, of some general bodily enfeeblement or disease; a thorough and searching physical examination should invariably be made.

Chorea is usually started by some reflex irritation, such as eye-strain, nasal irritation, tight prepuce, a bound-down clitoris, or lumbricoid worms; and secondary attacks may not always be true chorea. The patients can be divided into two classes: those that tend to get well under almost any, or even without treatment, and those who fail to obtain relief from medicine. In the latter the percentage of hypermetropia, usually latent, is extremely large, apparently about 70 per cent.; and an investigation of latent heterophoria should always be made, in choreic subjects, with the greatest care and patience. Finally, the spasmodic movements which accompany and indicate organic lesions of the brain—as, for example, those of leptomeningitis—exist

in but a small proportion of choreic subjects, and are usually associated with other evidences of disease. Tompkins (*Amer. Jour. Obst., Mar., '97*).

Especial attention should be given the intestinal tract and stomach, renal disorder, or any state of autogenous poisoning, anæmia, malarial poisoning, the presence of intestinal parasites, etc.

The use of morphia, chloral, chloroform or other sedative for the suppression of the muscular movements is of questionable propriety in any case, and will usually prove injurious.

Antipyrine in large doses: 4, 8, or 15 grains, according to age, repeated 2, 3, or 5 times a day; may be continued weeks without ill effect. Comby (*La France Méd. et Paris Méd., Sept. 6, '95*).

Antipyrine had a beneficial effect in 40 out of 60 cases, but in three-fifths of these cases the affection recurred. Where the drug failed the failure was due to intolerance or cutaneous eruption, but in a few cases it seemed to have no effect. It was found necessary to give large doses; doses from $\frac{1}{2}$ to $1\frac{1}{2}$ drachms were well tolerated for some weeks. Leroux (*Revue Mens. des Mal. de l'Enfance, June, '91*).

When the usual remedies fail, gel-semium in 2- to 5-drop doses four times a day should be tried. H. H. Nottage (*Jour. Amer. Med. Assoc., May 28, '98*).

Severe typical case of Sydenham's chorea rapidly cured with camphor bromide, increasing from $\frac{1}{2}$ to $2\frac{1}{4}$ drachms a day during twelve days, again decreasing to $\frac{1}{2}$ during next fifteen days. Bourneville and Katz (*Progrès Méd., July 16, '98*).

Satisfactory results from antipyrine given according to Eskridge's method. The drug is given in increasing doses, beginning with 1 grain for each year of the child's age, and increasing 1 grain each day. In the mildest cases the child is allowed to sit up a part of a day, and the antipyrine is only given in the evening, but in severe cases absolute rest in bed is necessary, the dose of antipyrine being given three times a day. The drug

is stopped as soon as the choreic movements cease or greatly diminish. Fowler's solution and iron are given until two or three weeks after the cure appears to be complete. In giving such doses of antipyrine (20 grains three times a day to a child 8 years old) the child must be kept in bed and carefully watched; should there be heart disease or any fever, it is not given. Rapid cures were obtained in nineteen cases so treated. S. D. Hopkins (*Philadelphia Med. Jour., Aug. 19, '99*).

Physostigma (Calabar bean) used in two extremely violent cases of chorea. Results were better than those usually obtained by the treatment with arsenic. Extract of physostigma was given in doses of $\frac{1}{16}$ grain, three times a day. J. W. Russell (*Birmingham Med. Review, Sept., 1900*).

Very many of these cases are habit cases, induced by some trivial local source of irritation or reflex influence not of central origin. In such, static electricity plays a double rôle, and is uniformly successful if applied early. (1) It lessens the irritability and (2) acts as a powerful suggestive influence when systematically employed.

Most cases of central origin are not due to any traceable organic defect, but are induced by functional derangement. Such are capable of being cured if not of too long standing. For treatment, a metal electrode covering the affected muscles is applied and held in position with the hand, and the wave-current is employed with as long a spark-gap as can be used without causing painful muscular contractions. Sparks to the region will also render the results more effective in some cases. If the condition is suspected to be of central origin, a large electrode to the back or abdomen should be used, as in epilepsy, for an additional fifteen minutes for its general effect. Under this régime there are few cases of not more than two years' standing that will not yield. W. B. Snow (*Journal of Electrotherapeutics, Dec., 1901*).

After recovery from chorea especial care should be exercised in the education

and bringing up of the child. A display of good judgment and the intelligent direction of conduct and development will be well repaid in increased stability and safety from relapse or from the subsequent occurrence of some other and more serious neurosis.

The treatment of chorea insaniens is practically the same as that of an outburst of acute mania. Active measures—eliminants and nerve-sedatives—are indicated.

Anomalous Varieties of Chorea.

The other conditions described under the name of chorea are:—

Endemic chorea, or epidemic chorea, a form of acute chorea with hysterical symptoms which develops in a number of persons at or about the same time in the same school or community. Suggestion plays an important part in its etiology.

Hysterical chorea: Closely allied to the above, but with the characteristic symptoms of hysteria superadded. The so-called "chorea major" is a purely hysterical phenomenon, and is not a chorea at all.

Electrical chorea is the name given to certain forms of acute chorea in which the movements are sudden and lightning-like in onset, and also to a state in which sudden rhythmical muscular contractions occur, simulating a "*tic co-ordiné*." The term is loosely employed, and is used in a different sense by different authors.

Procursive chorea, or "chorea festinans," is a form of chorea with hysterical accompaniments in which rhythmical dancing and procursive movements are prominent, vertigo being often present at the same time.

Saltatory spasm is a choreoid affection sometimes occurring in epidemics, and characterized by peculiar jumping and

dancing movements, which are executed when the patient is startled in any way. It is closely related to the forms of muscular clonic spasm affecting a few or many groups of muscles of the body to which the name "*tic convulsif*" is given. It is also spoken of as "*lata*." It occurs in degenerates of hysterical tendencies, is often accompanied by the unconscious and involuntary repetition of words and phrases and actions seen or heard, and by the involuntary repetition of obscure words.

Oscillatory or nodding spasm, spasm nutans, is characterized by rhythmical wagging or nodding movements of the head occurring in paroxysms or continuing for hours, or even during the entire time the patient is awake. It occurs in extreme degenerates, and may be complicated with epilepsy or other neurosis, or may accompany a hemiplegia or other secondary degeneration. It shades imperceptibly into "*habit chorea*."

Tic co-ordiné, or habit chorea, consists in the involuntary occurrence of tricks of speech or gesture—a twist of the head, shrug of the shoulder, etc. It is sometimes a result of an early attack of acute chorea, but occurs also as a primary affection, and may be inherited.

Post-hemiplegic chorea is a name given to the irregular rhythmical or arrhythmical jerky movements sometimes seen in hemiplegic limbs. Similar movements may occur as a result of infantile cerebral palsies.

Chronic adult chorea is characterized by choreic movements associated with spastic symptoms and progressive mental deterioration. There is always marked degeneration in cortical cells and in pyramidal tracts. If there is a history of chorea in ancestry this "chronic adult chorea" is called "Huntington's" or "hereditary chorea." The affection was

described fifty years ago in America, but has obtained general recognition only since Huntington called attention to it in 1872. In typical cases the disease develops insidiously, slowly progresses, and terminates in marked spastic paralysis with advanced dementia, or in death. It is closely related, in etiology, pathology, and clinical features, to general paresis, into which it probably shades by insensible degrees.

Careful pathological study made of case of Huntington's chorea. Investigation of family history showed that nine members, beginning with patient's grandfather, had been affected. The changes consisted in a chronic parenchymatous degeneration of the cortex, with consecutive changes in the interstices and vascular system. The belief expressed that the cells are originally properly formed, but that they are not endowed with their normal longevity.

In Huntington's chorea, drugs, if given at all, must be administered in the largest possible, almost toxic, doses, for a long period of time. The marriage of persons with a heritage of Huntington's chorea should be discouraged. Joseph Collins (*Amer. Jour. Med. Sciences*, Sept., '98).

Case in which the essential lesion consisted in the diminution in size of nervous elements generally, an increase in pigment content of the nerve-cells, especially in those of the cerebellum; an overgrowth of neuroglia tissue,—the relation of which to the nervous elements seems to be passive and possibly accounted for by the so-called "tissue tension,"—a shrinkage of the cells in the dorsal root ganglia with the analogous proliferation of the endothelial cells of their capsules, a pigmentary degeneration of the neuroglia, and a degeneration of the white matter about the periphery of the cord. G. Y. Rusk (*Amer. Jour. of Insanity*, July, 1902).

These forms of choreic movements with degenerations in brain and cord are, of course, incurable.

It will be seen that the term chorea has been applied to numerous and

widely-different affections, insuring some confusion, as previously remarked. It is unfortunate that the name of "chorea" cannot be entirely restricted to mean the acute or Sydenham's chorea, since this is a tolerably-well-defined group of clinical symptoms, with a definite course and character. The other varieties of chorea are symptoms of hysteria and extreme degeneracy or of chronic degeneration in motor cells and tracts, and should preferably be relegated to their proper nosological place.

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Mobile.

CHOROID. See IRIS, CILIARY BODY, AND CHOROID.

CHROMIC ACID.—This is an anhydride, found as brilliant, crimson-red, acicular, deliquescent crystals that are most freely soluble in water. It is prepared by mixing a solution of potassium bichromate with sulphuric acid, rejecting the crystals of acid sulphate of potassium which crystallize out, heating the liquor, and adding more sulphuric acid, when the chromic acid is formed by crystallization. It is also soluble in ether that is free from alcohol and water. It is decomposed by most acids—lactic, sulphurous, hydrosulphuric, hydrochloric, arsenous, etc.; by glycerin; and is likely to cause explosion if mixed with the latter or with alcohol.

Preparations and Doses.—Chromic anhydride (chromic acid), external use only.

Chromic-acid liquor (1 part to 3 of distilled water), external use only.

Physiological Action.—Chromic acid possesses the power of killing all low organisms, oxidizing organic matter, coagulating albumin, and destroying the tissues with which it comes in contact. It is thus antiseptic, disinfectant, and

powerfully caustic. Made into a paste with water, its action is exceedingly slow and gradual, but deeply penetrating; in saturated solution it is less penetrating and slower in action. By employing a solution more or less dilute, the action may be graduated according to the effects desired. Death has resulted from absorption when it has been applied too freely. Its local effects are, for the most part, antagonized by bland neutral fats, applied in excess. The toxic effects are similar to those of potassium bichromate.

Therapeutics.—AS AN ANTISEPTIC AND DISINFECTANT.—Two drachms of chromic anhydride added to 4 or 5 quarts of water gives an inexpensive, but efficient, antiseptic and disinfecting lotion for leucorrhœas, ozænas, hyperidrosis, putrid sores, etc.; a lotion of 10 grains to the ounce has a decided effect upon syphilitic, gouty, and kindred maladies of tongue and throat. As a local application to cancerous and other ulcerations, it is preferable to all other caustics, since the pain attendant on its application is trifling; but it must be used cautiously and discriminatingly.

MORBID GROWTHS.—A concentrated solution is useful in removing syphilitic condylomata and warts and other morbid growths from the genital region. It has been applied to external and bleeding hæmorrhoids, to fungus hæmatodes, onychia maligna, and onychia parasitica with great benefit. Warts quickly yield to the application of chromic-acid crystals, after the surface of the growth has been slightly moistened.

TRACHOMA.—Some years ago a French oculist (Hairion) employed, with advantage, a solution of equal parts of acid in distilled water, applied with a camel's-hair pencil to obstinate granular ophthalmia. The applications were made at

intervals of four, six, and eight days, and, although it was never very painful or followed by any great amount of reaction, it admits of great doubt how far so deeply a penetrating caustic can, with safety, be applied to so delicate an organ on the eye.

DISEASES OF THE AIR-PASSAGES.—But the greatest availability appears to be in treating diseases of the throat, upper pharynx, and nose. Owing to its hygroscopic character, no agent is so effective when applied to nasal polypi, and it is also highly recommended in hypertrophic rhinitis. In either case the most convenient method is to heat the tip of an ordinary probe and touch it to one of the acicular crystals of acid; enough adheres for two applications, but care must be taken not to overheat the instrument, lest decomposition of the chromic anhydride should occur, and an insoluble compound be formed.

CHRYSAROBIN.—This drug, also known as “Goa powder,” “Araroba powder,” “Po de Bahia,” and also (improperly) as “chrysophanic acid,” is the metamorphosed heart-wood of the *Andira araroba*: a leguminous tree indigenous to Brazil. It is a brownish-yellow crystalline powder, permanent in the air, tasteless, odorless, almost insoluble in water, slightly so in alcohol, completely in ether, containing a variable amount—70 to 80 per cent.—of chrysophan, which latter, by oxidation, is readily transformed into chrysophanic acid.

Chrysophanic acid is a neutral substance, identical with rhein, the active principle of rhubarb. It is commonly found as a granular, orange-yellow powder, but sometimes takes the form of bright, shining-yellow needles: a transformation that is effected by sublimation. It is odorless, acrid, soluble in

alkaline waters, oils and fats, chloroform, petroleum spirit, and glycerin; but is insoluble in water, alcohol, and ether.

Preparations and Doses.—Chrysarobin, $\frac{1}{8}$ to 5 grains.

Chrysophanic acid, $\frac{1}{8}$ to $\frac{1}{2}$ grain; as an emetic and purge, 8 to 20 grains.

Chrysarobin ointment (acid. chrysophanic., 1; benzoated lard, 24).

Compound chrysarobin ointment (chrysarobin, 5; salicylic acid, 2; ichthyol, 5; vaselin, 88).

Chrysarobin pigment (acid. chrysophanic., 1; solution of gutta-percha, 9).

Araroba ointment (chrysarobin, 6; glacial acetic acid, 1; lard, 14).

Bismuth chrysophanate, external use as an antiseptic only.

Zinc chrysophanate, an antiseptic dusting-powder.

Physiological Action.—In general the action of chrysarobin and chrysophanic acid, when given internally, is not understood, but Brunton and Delépine believe the latter to be an hepatic stimulant, and that it, at the same time, produces a marked increase in the glycogen of the liver. It may be added, however, that chrysarobin is an active irritant poison, and even in minute doses induces gastro-intestinal disturbances, such as vomiting and purging. There is nothing to the credit of either drug that should lead to its use as an internal remedy.

Externally, chrysarobin is an irritant to the skin, staining it yellow; and, applied in excess, produces irritation and inflammation, accompanied by swelling, itching, pain, heat, and sometimes a papular eruption; and the action is not always limited to the part to which it is applied, but extends to the healthy skin in the vicinity.

Chrysophanic acid does not cause discoloration, but it is much less active

than chrysarobin, and does not, in any sense, represent the true principles of the latter.

Therapeutics. — SKIN DISEASES.

There is no doubt that chrysarobin is a remedy of value in parasitic skin diseases, and especially in psoriasis, but chrysophanic acid is far from upholding the repute of its derivative.

Chrysophanic acid does not stain like chrysarobin, and is scarcely at all irritating; but comparative experiments made with the two substances in the treatment of psoriasis lead to the conclusion that the former is not an efficient substitute for the latter in the treatment of this disease. Walter G. Smith (Brit. Jour. Derm., July, '96).

Though at various times recommended in the management of acne and eczemas, chrysarobin is seldom of value.

CHYLURIA.

Definition.—A peculiar condition of the urine in which it presents a milky, or chylous, appearance and contains the constituents of chyle, especially fat and albumin.

Varieties.—Two varieties of chyluria have been observed: (1) the tropical chyluria, which is of parasitic origin; (2) the non-tropical chyluria, the cause of which is unknown.

Symptoms.—Chyluria presents an extremely-varied clinical history, and the descriptions given of cases are most diverse. Its course is marked by an irregularity and capriciousness which cannot be explained. The only constant symptom is the presence of so-called chylous urine. This fluid usually presents a peculiar whitish, opaque, milky appearance; sometimes the color is not whitish, but pink from the presence of blood. Occasionally the blood is not intimately mixed with the urine and very soon forms an adherent coagulum at the bot-

tom of the vessel. In many cases, the urine, after some standing, will form a superficial stratum resembling cream or *blanc-mange*. The odor of the urine is ordinarily acid, rarely urinous; its reaction acid or neutral, rarely alkaline. Chylous urine ordinarily decomposes speedily and will then smell of sulphureted hydrogen. Sometimes it has been observed that chylous urine could be kept for months without fermenting. The specific gravity of the urine as well as its appearance varies greatly in the same person at different times, even at different periods of the day. The urine may, in some cases, contain coagula before evacuation, which may cause local disturbance and pain while it is being passed. When blood-serum is added to chylous urine, large coagula will ordinarily form.

Microscopical examination of the urine shows that it contains fat in molecular form, but milk-globules or large drops of fat are not seen; the urine further contains leucocytes and blood-corpuscles, both white and red. In some cases crystals of uric acid have been observed, when the reaction of the urine is alkaline, the characteristic crystals of phosphate of ammonia—magnesia—are observed. Frerichs relates that in one case he found the urine to contain a multitude of ripe and unripe spermatozoa. In the tropical variety of chyluria, Lewis, in 1870, and after him many other investigators, found the embryos of *Filaria sanguinis* in the urine.

By shaking the urine with ether, the fat molecules are dissolved and the urine clears up, completely or partially. Besides, the ordinary fat-cholesterin and lecithin have also been found.

Chylous urine always contains albumin, generally in the form of serum-albumin; but globulin, albumose, and

pepton may likewise be present. Casein has never been observed; sugar is not ordinarily contained in chylous urine, but Pavy and Habershon are said to have found it in one case.

Quantitative estimation of the contents of chylous urine have been made in great number; the amount of fat varies from 0.028 to 3.3 per cent., while the albumin was found in a quantity of 0.12 to 2.7 per cent. As may be seen, their relative proportion varies much.

The discharge of chylous urine usually occurs very suddenly; it may be constant, but more frequently is intermittent. The chyluria may cease for months and years and reappear without appreciable cause, even if the patient has made a complete change of climate. The urine is, in many cases, chylous only in the early hours of the day, or presents, at that time, a much larger quantity of chyle than at other periods of the day. This intermittence has been observed as well in the tropical as in the non-tropical varieties of chyluria. In some instances the position of the body—recumbent or erect—is found to bear influence.

Case in which chyluria occurred only in one micturition, after a fall from a height of about ten feet upon a lot of stones, from which it is probable that there occurred a rupture of a lymphatic at some point in the urinary tract. Hunt (Brit. Med. Jour., Feb. 22, '90).

Case of chyluria with complicated nervous symptoms (hysteria) the cause of which was made clear by the expulsion of a specimen of *Eustrongylus gigas* nine centimetres in length and four millimetres in diameter. Pasquale Moscato (Riforma Medica, Sept. 26, '93).

Case in a man, 57 years old, who had been in Florida for awhile. He can bring on a chyluria by lying down an hour, and more readily if he lies on the back than on the side. The *Filaria sanguinis* found by Dr. Ernst in his blood. Vickery (Boston Med. and Surg. Jour., Dec. 16, '97).

1. Chylous urine may result from a fistulous communication between the lymphatic and urogenital system. 2. It may also be due to lipæmia, the kidneys secreting a fatty urine. 3. Tropical chyluria is always parasitic and due to the *Filaria sanguinis hominis* or *Distoma hæmatobium*; non-tropical chyluria not dependent on lipæmia may be caused by the *Eustrongylus gigas* and possibly also by *Tania nana*. 4. The pathology of the non-parasitic types is not known, but these may depend on tumors, peritoneal adhesions, etc. 5. Certain peculiarities of the non-tropical disease—such as the absence of sugar in the urine, the occurrence of periodical attacks, and the varying composition of the urine during the twenty-four hours—require further explanation. W. E. Predtetschensky (Zeits. f. klin. Med., B. 40, H. 1, 1900).

In most cases symptoms referable to the urinary organs are noticed, such as pains in the lumbar region, along the urethra, etc. Occasionally the urine coagulates in the bladder, causing pain and difficulty during micturition.

Persons suffering from chyluria may enjoy good health, but generally there is weakness, wasting, with mental depression. Tropical chyluria is often accompanied by fever and diarrhœa.

Chyluria follows a very chronic course.

Diagnosis.—Chyluria may resemble pyuria and lipuria; it can be distinguished from both by microscopical examination; in pyuria the urine contains innumerable pus-corpuses; in lipuria the fat is not present in molecular form, but in large drops or in fine needles and crystals.

Etiology and Pathology.—The tropical, or parasitical, variety of chyluria is the best known, and its etiology has been elucidated by different authors. It has been observed in the United States, China, Japan, Siam, the Isle of France, Brazil, the East Indies, Egypt, Reunion, Mauritius, Australasia, and recently also

in Europe in persons who never had lived in tropical regions. Tropical chyluria is caused by the presence in the blood of the embryos of *Filaria sanguinis hominis*: a nematoid worm.

These embryos were first found in the urine by Wucherer, of Bahia, and later also observed in the blood by Lewis. Their natural history has been elucidated by many observers, especially by Manson.

The adult filaria has a length of from 30 to 40 millimetres and is filiform: the embryo measures 0.0075 millimetre in diameter and 0.34 millimetre in length. Manson found that the parent filaria live in the lymphatics on the distal end of the glands; they are oviparous and their eggs are arrested in the glands and hatched there. The free embryos then pass along the lymphatic vessels and enter the circulation. Resting in some organ during the day, they circulate with the blood during the night, or, as Mackenzie has shown, they rest during the sleep of their host, whether it be night or not.

Manson describes four varieties of filaria:—

Filaria nocturna, which can be detected in the blood only at night.

Filaria diurna, which is found in the blood during the day only.

Filaria perstans, which is always present in the capillaries.

Filaria Demarquay, not half the size of the ordinary filaria.

Filaria diurna and *perstans* seem to be confined to the western part of Africa, while *filaria nocturna* is always present in tropical countries and is endemic in some parts of the United States of America.

Filaria are not more frequently present in the blood than the embryo of *Bilharzia hæmatobium*. Diago (Cronica Médico-Quirúrgica de la Habana, p. 35, '90).

Study of the blood of about sixty negroes belonging to the different tribes of the Congo States. Embryos of filaria in the blood of the majority of them found. Filaria were also found in the blood of a negro from the Congo who had been living in Belgium for six years. Firket (Annual of the Univ. Med. Sci., vol. i, D-29, '96).

It has not yet been proved in what manner the embryos of the filaria give rise to chyluria, but it is commonly believed that the parasites obstruct the lymphatics and cause their delicate walls to rupture, or that they perforate the walls of the chyloferous vessels and bring about abdominal communications.

It has already been mentioned that chyluria presents an extremely varied clinical history and may be accompanied by divers other symptoms, such as chyluric discharges from various parts of the body, with elephantiasis, lymphangiectasis, etc.

The diversity of the clinical manifestations may, perhaps, find its explanation by the fact that it is not always caused by the same species of filaria.

The non-tropical variety of chyluria is not of parasitical nature, and its origin is, as yet, quite obscure; it occurs even in cold climates, but is a very rare disease.

Case of chyluria occurring in a woman aged 67 years. The symptoms developed during an attack of croupous pneumonia of the left lower lobe, on the ninth day of the disease. The urine resembled much the appearance of coffee weakened by a large excess of milk. No filariæ were found in the blood. Wehlau (Med. Record, Feb. 15, '90).

Case of chyluria observed in a boy of 11 years, who had never left the town of Riga, Russia. Bernsdorf (Annual, vol. i, F-43, '95).

Manson's observations seemed to show that the embryos were taken along with the blood in the stomach of a certain form of mosquito in which they undergo

developmental changes. After some days the mosquito discharges its eggs in the water of some pool and the filaria there becomes free, and by this medium the animals are conveyed to the human system, through drinking the water.

Mosquitoes seem to be the active agents by which the disease is propagated. The mosquito bites a man or an animal affected with the filarial disease. The filaria curls itself around the proboscis of the mosquito, is sucked into the stomach of the insect, passes into its tissues, grows, and develops there. When the mosquito dies the worm is set free, and, getting into drinking-water, is again introduced into the human subject through the stomach and alimentary canal. Byrom Bramwell (Brit. Med. Jour., July 31, '97).

In some cases very small drops of fat have been observed to circulate with the blood and to be discharged through the kidneys; in some instances the authors favor the belief that the urine is secreted in its normal state, but that the fat is added during its passage through the ureters and the bladder.

Prognosis.—Chyluria is ordinarily a disease of long duration. Sometimes the patients recover spontaneously; in other cases it leads to anæmia and severe diarrhoea and the patient dies from exhaustion.

Treatment.—Medicine seems to have but little influence on chyluria. Rest, good nutritious diet which is not too exclusively animal, the use of pure water for drinking purposes, iron, and quinine have been recommended, as well as large doses of iodide of potassium. Against the parasitic chyluria anthelmintics have been tried, as methylene-blue (Austin Flint, Annual '96, vol. i, D-80) and thymol (Crombie, Annual, '96, vol. i, D-81). In the tropics a plant—pentaptyl-lum—is much relied upon; mangrove-bark is considerably used in Guiana.

Case of filarial chyluria in whom, other treatments having failed, thymol was administered in 1-grain doses every four hours, this dose afterward being doubled. Under this medication the filariæ disappeared after a few weeks from the blood, and the urine gradually improved until in about two months it had resumed its normal character. Two months later no recurrence of the pathological condition had taken place. Lawrie (Indian Med. Rec., Mar., '90).

Methylene-blue tried in a case of chyluria due to the *filaria sanguinis hominis*. The effects of the drug were decided and prompt. After the administration of 2 grains every four hours during the day, on March 5th, the parasites were very few at 11 P.M.; the only two found were deeply stained with blue and their movements were extremely sluggish, the urine being clear, but intensely blue. On the fourth and the seventh days no parasites were found, although the treatment had been discontinued after the first day. On the eighth day the urine became milky, and on the night of the ninth day the parasites were found in great number, but their movements were not very active. On the tenth day the treatment was resumed and continued for five days. Three days after, the blood being examined at night, a very few motionless filariæ were observed. Since that time, and up to the present writing (more than a year), the urine has been normal and the patient has been restored to perfect health. Austin Flint (N. Y. Med. Jour., June 15, '95).

Case of chyluria, the first of the kind observed in Philadelphia. Microscopical examinations of the blood drawn from the finger showed that the parasites were very few in number or absent from the blood during the day; they were, therefore, the variety known as the *Filaria nocturna*. Methylene-blue in 2-grain capsules every three hours was ordered. After being taken continuously for seventy-two hours the blood was found to contain actively-moving unstained filariæ. The urine and feces were stained a deep blue; the milk was uncolored. After being taken for nine days the drug proved absolutely inert so far as any in-

fluence on the vitality of the embryos was concerned, and it did not stain them until they were dead. F. P. Henry (Med. News, May 2, '96).

Two cases of chyluria in which recovery took place rapidly under the use of ichthyol in daily amounts of 7 or 8 grains, in the form of pills. Moncorvo (Nouveaux Remèdes, Dec. 8, '97).

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CILIARY BODY. See IRIS, CILIARY BODY, AND CHOROID.

CIMICIFUGA.—Black cohosh or black snake-root. The rhizome and rootlets of the *Cimicifuga racemosa*, a perennial plant found in the United States and Canada, contains an acrid, neutral alkaloid, soluble in water, dilute alcohol, chloroform, and ether, and two resins, one of which, cimicifugin, is precipitated from the tincture of cimicifuga when water is added to the latter.

Preparations and Dose.—It is important that all preparations of this drug be made fresh, since they deteriorate upon keeping.

Fluid extract, $\frac{1}{2}$ drachm.

Extract, 1 to 5 grains.

Tincture (20 per cent.), 1 to 2 drachms.

Cimicifugin or macrotin (resin), $\frac{1}{2}$ to 2 grains.

Physiological Action.—Cimicifuga was extensively employed by the aborigines of North America as an abortifacient, its action in this particular greatly resembling that of ergot. It may be used when the latter drug cannot be obtained as an ecboic, not only during parturition, but in post-parturition hæmorrhage. In moderate doses cimicifuga acts as a diuretic and tends to increase the bronchial and cutaneous secretions, while in small doses it stimulates digestive functions, acting as a bitter tonic. Its influence upon the heart resembles that of digitalis; large doses increase

arterial tension and cardiac action, while the pulse is slowed. The latter result being secondary, the use of the drug, when the walls of the organ are diseased, becomes dangerous in large doses.

Poisoning by *Cimicifuga*.—A typical case of poisoning which occurred in the person of a physician will best illustrate the effects of an excessive dose.

Dr. I. N. Brainard took 3 drachms of the fluid extract of *cimicifuga*, and the effects produced by the drug are by him described as follows: In about half an hour had a feeling of fullness in the head; the face was flushed; there was a sensation of warmth all over the body, with vertigo, which was increased when in the erect posture. There was considerable pain at the end of the spine. After an hour had elapsed all these symptoms were accentuated. There was redness of the eyes, but the pupils were normal, as was also the bodily temperature. The pulse was 100 and full, and there was marked increase in the arterial tension. At no time was there any slowing of the pulse or any signs of cardiac depression. The headache now became excessively severe, and the spinal cord was apparently much stimulated. The muscles in the back, arms, and legs were hard and trembling. Two hours later these symptoms continued with increased severity, and nausea then appeared. There was increased peristalsis, but no purging. Four hours after taking the poison he drank some warm water, and vomited three times during the next five hours. The symptoms continued, nevertheless, until the eighth hour. The headache was so exceedingly severe that it was necessary for his wife to anæsthetize him with chloroform. There was a great deal of backache and restlessness. Eight hours after the drug was taken sleep came on, from which he awoke several

times with marked priapism. The effects upon the spinal cord and nerves were felt for a little over two days. There was considerable increase of bronchial secretion, but no increase in the urinary flow or in the secretion of the skin was noticed during the entire period of the paroxysm.

Therapeutics.—As may be surmised from its physiological properties, *cimicifuga* has been recommended in almost every disease, but, being superior to very few drugs which possess special properties of a more restricted kind, it has gradually been replaced by these. Its most marked effects are probably witnessed in the treatment of acute rheumatism, and, according to Ringer, in rheumatoid arthritis. N. H. Bentley found the fluid extract valuable in rheumatic myalgia, while Balfour obtained considerable assistance for the relief of pain in disorders of neuralgic origin. Grouping the various results reported, it would seem to possess analgesic action, its diuretic properties tending, at the same time, to rid the economy of products of metabolism: the keynote of relief in rheumatic disorders.

Another disorder in which *cimicifuga* sometimes proves superior even to arsenic is chorea, when administered in full doses. Its action in this disease is due to its influence upon the reflex centres of the spinal cord.

Cimicifuga valuable in tinnitus aurium.
Conclusions:—

1. Buzzing of the ear may be considered as the reaction of the auditory nerve to direct or reflex irritation.
2. *Cimicifuga racemosa* possesses an action upon the auricular circulation and upon the reflex irritability of the auditory nerve; the average active dose is 30 drops of the extract a day.
3. Buzzing which has existed more than two years appears difficult to influence by *cimicifuga*. Albert Robin and Mendel (N. Y. Med. Jour., July 23, '98).

As already stated, it may be substituted for ergot in obstetrical practice when the latter drug cannot be obtained, but it is not as reliable. Its influence upon the uterine circulation and the involuntary muscular fibre causes it to be very effective in cases of uterine congestion whatever be the cause. It is, therefore, frequently employed in amenorrhœa, dysmenorrhœa, delayed menstruation, the menopause, etc., when congestion of the uterus and adnexa plays an active part in the morbid process.

CINCHONA.—Cinchona, or cinchona-bark, was first brought to Europe some time in the seventeenth century, but just exactly when or how is not really known, though a great number of idle and fanciful tales are extant that purport to account for its introduction. It was certainly employed medicinally as early as 1640, though its most prominent alkaloid, quinine, was not discovered until 1820 (see QUININE).

Some thirty-six species of cinchona are recognized, and, when the number of hybrids is considered, the total is considerably augmented; but at the same time only seven constitute the source of the principle "barks" and alkaloids of commerce, as follows:—

Brown, pale, Loxa (or Loja) bark, obtained from *Cinchona officinalis* and the varieties *condaminea*, *bonplandiana*, and *crispa*; red bark, from *C. succirubra*; gray, or silver, bark, from *C. nitida*, *C. micrantha*, and *C. Peruviana*; yellow bark, from *C. calisaya* and its variety *Ledgeriana*; Columbian or Cartagena bark, from *C. lancifolia* and *C. cordifolia*; Pitayo bark, from *C. pitayensis*; and Cuprea bark from *Remijia Purdieana* and *R. pedunculata*, the last two being forms seemingly intermediate as to the true and false cinchonas. All are

evergreen trees or shrubs that favor mountain-ranges and slopes at elevations varying from 400 to 11,500 feet above sea-level; they average from 30 to 80 feet in height, and measure from 1 to 2 feet in diameter at the base. The leaves resemble those of the laurel, are entire, of varying shape, the best pitted—or with numerous small shallow depressions—on the under-side (except *C. succirubra*) and a prominent mid-rib; flowers tubular, fragrant, rosy-white, or purplish; fruit-capsule two-celled, splitting from the base upward, and containing many winged seeds. All are indigenous to the Andean region of South America, and the pale, red, and yellow barks constitute the chief imports; the cuprea-barks are little used. Pale and red barks, the product of cinchona plantations in India, instituted and fostered by the government, are also obtained, arriving from Madras and other seaports on the Bay of Bengal. There are likewise plantations in Ceylon, the Malay Peninsula, in South Africa, Jamaica in the West Indies, and a very rich form of *Ledgeriana* and *calisaya* is obtained by way of Amsterdam or Hamburg from the plantations of the Dutch Government in Java. Formerly the trees were felled close to the ground and stripped of bark, not even the branches escaping, but of recent years the discovery was made that a more profitable yield could be obtained by merely removing the bark in strips or sections from the standing tree, the decorticated portion being renewed if protected, and as rich in alkaloids as before; also that the yield of alkaloids could be materially increased by covering the bark with moss or matting, thereby preventing the rays of the sun from converting the alkaloids into coloring matter. Again, it has been found that by careful selection of favorable species, and by

crossing and again selecting, barks may be produced that will yield double or even treble the quantity produced by the best non-hybrid varieties.

The *calisaya* is one of the most important of the "barks," inasmuch as quinine constitutes from one-fourth to three-fourths of the total alkaloidal yield. The old "natural flat bark," the product of felling and stripping, is no longer met with, but, instead, so far as the United States is concerned, the major portion is a yellow bark rolled from flat pieces, coming from Bolivia; there are also "quilled" and doubly-quilled varieties, of variable thicknesses, from 3 inches to 2 feet long, $\frac{1}{4}$ to $2\frac{1}{2}$ inches in diameter and $\frac{1}{12}$ to $\frac{1}{6}$ inch thick, with a longitudinally-wrinkled and transversely-fissured, brown epidermis, the latter practically tasteless and inert, and easily separated from the inner or medicinal portion. This bark is of short, fibrous texture, compact, presenting shining points wherever broken, of brownish-yellow hue, faint odor, and bitter, slightly-astringent taste.

The *red bark* has many alkaloids, but does not yield as much quinine as the *calisaya*. It comes in quills and flat pieces, varying in thickness from $\frac{1}{8}$ to $\frac{1}{4}$ inch, is of deep-brown or brown-red color, and gives a short, fibrous fracture. The epidermis is covered with warts and ridges; the inner surface rather coarsely striated. It gives a powder of a deep brown-red hue that is slightly odorous, but astringent and bitter.

Pale barks also come in cylindrical pieces of variable length, sometimes singly, sometimes doubly "quilled," are from $\frac{1}{6}$ to 1 inch in diameter and from $\frac{1}{24}$ to $\frac{1}{6}$ (more rarely $\frac{1}{4}$) in thickness. The exterior surface is rough, of a grayish color, with transverse, and sometimes longitudinal, fissures; interior surface

either rough or smooth, according to the period of gathering; fracture smooth, with some short filaments on the inner surface; faintly-aromatic odor, and moderately bitter and astringent taste. Of the total alkaloids, from 50 to 65 per cent. is quinine.

Huanuco, or *gray bark*, of a cultivated variety and much richer than the pale forms in quinine, is now obtained from Jamaica. The quills are frequently somewhat spirally rolled, and on the epidermis are numerous short, irregular, transverse cracks; the edges are flat, scarcely separated or everted; the outer surface is whitish or of a clear silvery gray, or in the smaller quills of a uniform whitish-gray; inner surface yellow, yellowish-red, sometimes cinnamon-brown; smooth in small quills and fibrous in large; fracture smooth and resinous, odor clayish and pleasant; taste astringent, aromatic and bitter. The bark from *C. nitida* is not wrinkled longitudinally on the derm, and the inner portion is of a more or less brown hue; but the product of *C. micrantha* is often wrinkled longitudinally, though almost devoid of transverse fissures; it has a rusty-yellow interior. As obtained uncultivated from South America, these gray barks yield less than 3 per cent. of alkaloids, often but 1.5 per cent., of which but from $\frac{3}{10}$ to $\frac{3}{5}$ per cent. is quinine.

Columbian, or *Cartagean*, barks are of two forms. That from *C. lancifolia* is chiefly from young stems and branches, are usually "quilled" and coated with a brownish-yellow epidermis, in turn perhaps coated with white crustaceous lichens, causing it to assume a grayish or silvery appearance. The quills vary in size from $\frac{5}{8}$ to $1\frac{1}{2}$ inches in diameter, some being rather smooth, others rough, owing to numerous short, slight, longitudinal and transverse cracks; edges

slightly everted; extremely fibrous and moderately bitter. It is not uncommon to find the "quills" *trimmed*: i.e., with the epidermis removed. The interior may be reddish, orange-yellow, or yellow; hence it is not always easily distinguished from the gray barks. The *cordifolia* form occurs both as flat pieces and as fine, middling, and thick quills; the flat pieces more or less twisted, arched, and warped; from $\frac{1}{2}$ to 2 inches broad, 4 to 8 or 12 inches long, and $\frac{1}{8}$ to $\frac{3}{4}$ inch thick. The quills vary from 5 to 12 inches in length, are from $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter, and $\frac{1}{24}$ to $\frac{1}{4}$ inch thick, and also are frequently deprived of epidermis. The interior surface of both forms varies from smooth to fibrous, the prevailing hue being of a pale-ochre yellow, in old species brownish. The fibres often project obliquely, giving a scaly, fibrous appearance. The epidermis, when present, is observed of a whitish, yellowish-white or ash-gray hue, with irregular, flexuous, longitudinal, but not very deep furrows. The fracture, if transverse, is short, internally more or less fibrous, externally corky; longitudinally it is uneven, short, coarse, and splintery, and often effected only with difficulty. The powder is of cinnamon-hue, moderately bitter and astringent. Both the foregoing barks vary materially in their yield of alkaloids.

Petaya bark is of little interest save to manufacturers of alkaloids, and contains from 1.5 to 1.8 per cent. of quinine. It comes in short quills or curly pieces of a brownish color, and is especially rich in quinidine.

The *cuprea barks* come in short red quills and broken pieces, and are not true cinchona-barks, but are here mentioned because they are a source of cinchona alkaloids; they contain quinine, quinidine, cinchonine, but no cinchono-

dine, and also cupreine: an alkaloid that exists in connection with the first named, and was formerly held to be a distinct entity to which the titles of "homoquinine" and "ultraquinine" were given.

The cinchonas are incompatible with tinctures of iodine, tannin, alkalies and alkaline carbonates; are antagonized by mercury, iodides, and the salts of lead, zinc, and copper.

Preparations and Doses.—Cinchona-bark, powdered,—all forms,—10 to 60 grains and upward.

Cinchona decoction (cinchona, 10 drachms; distilled water, 16 ounces), 1 to 2 ounces.

Cinchona infusion (cinchona, 1 ounce; water, 16 ounces), 1 to 2 ounces.

Cinchona infusion, acid (red bark, 4 drachms; boiling distilled water, 10 ounces; aromatic sulphuric acid, 1 drachm), 1 to 2 ounces.

Cinchona infusion, compound (red cinchona, 1 ounce; Virginia snake-root, 2 drachms; boiling water, 24 ounces; infuse and evaporate to 1 pint, and add 4 ounces of spirit of Mindererus), 1 to 2 ounces.

Cinchona infusion, inspissated, 30 to 60 minims (obsolete).

Cinchona extract, solid (pale and yellow forms), 5 to 30 grains.

Cinchona extract, solid (calasaya), hydro-alcoholic, 2 to 15 grains.

Cinchona extract, solid (red), 2 to 30 grains.

Cinchona extract, solid (red), alcoholic, 2 to 30 grains.

Cinchona extract, fluid (pale and yellow—5 per cent. total alkaloids), 5 to 30 minims.

Cinchona extract, fluid, aromatic, 20 to 120 minims.

Cinchona extract, fluid (red), 5 to 30 minims.

Cinchona extract, fluid (red), compound, 20 to 90 minims.

Cinchona extract, fluid (red), detannated, 20 to 90 minims.

Cinchona tincture (pale and yellow forms), 1 to 4 drachms.

Cinchona tincture (red), 30 to 120 minims.

Cinchona tincture (red), compound (Huxam's), 30 to 120 minims.

Cinchona tincture (red), compound (Whytt's), 30 to 120 minims.

Cinchona tincture, ammoniated, 30 to 120 minims.

Cinchona tincture, ferrated, 20 to 60 minims.

Cinchona-wine (cinchona tincture, 10 parts; sherry-wine and glycerin, of each, 30 parts), 1 to 4 drachms.

Cinchona-wine, aromatic, 1 to 4 drachms.

Cinchona elixir, B. P., 30 to 60 minims; U. S. P., 1 to 2 drachms.

Cinchonine crystals, 1 to 40 grains.

Cinchonine benzoate, 1 to 5 grains.

Cinchonine bisulphate, 1 to 30 grains.

Cinchonine iodosulphate, 1 to 3 grains.

Cinchonine and iron tartrate, 3 to 8 grains.

Cinchonine salicylate, 3 to 15 grains.

Cinchonine picrate, 1 to 3 grains.

Cinchonine sulphate, 2 to 30 grains.

Cinchonine tannate, 2 to 30 grains.

Cinchonidine crystals, 1 to 20 grains.

Cinchonidine bisulphate, 1 to 20 grains.

Cinchonidine borate, 1 to 10 grains.

Cinchonidine dihydrobromate, 1 to 10 grains.

Cinchonidine hydrochlorate, 2 to 20 grains.

Cinchonidine salicylate, 1 to 10 grains.

Cinchonidine sulphate, 1 to 30 grains.

Cinchonidine tannate, 5 to 15 grains.

Cinchonidine tartrate, 2 to 15 grains.

Quinetum (chinetum), 1 to 8 grains.

Quinetum sulphate, 1 to 8 grains.

Quinidine (chinidine, conchicine), 3 to 30 grains.

Quinidine bisulphate, 5 to 60 grains.

Quinidine citrate, 1 to 12 grains.

Quinidine dihydrobromate, 5 to 50 grains.

Quinidine hydrobromate, 5 to 50 grains.

Quinidine sulphate, 5 to 60 grains.

Quinidine tannate, 5 to 15 grains.

Quinoidine (chinoidine), 2 to 15 grains.

Quinoidine borate, 8 to 15 grains.

Quinoidine citrate, 5 to 25 grains.

Quinoidine hydrochlorate, 5 to 25 grains.

Quinoidine sulphate, 5 to 25 grains.

Quinoidine tannate, 5 to 15 grains.

Quinoline (true, from cinchonine), 15 to 30 minims.

Quinine, alkaloid, 2 to 15 grains (see QUININE).

Cinchona febrifuge (see QUINETUM, on pages 197 and 200).

Cupreine, 1 to 15 grains.

Cupreine sulphate, 1 to 15 grains.

Esencia de calasaya, 4 to 12 drachms.

Compound elixirs of cinchona (all kinds), 1 to 2 drachms.

Heberden's ink (aromatic iron and cinchona mixture), 1 to 2 ounces.

Homoquinine (mixture of quinine and cupreine), 1 to 15 grains.

Cinchonine and Salts.—The alkaloid appears as white shining prisms or needles, at first without much taste, but after being swallowed developing a distinct bitterness on tongue and palate; it is soluble in dilute acid, in alcohol 1 to 116, chloroform 1 to 163, and very slowly so in ether and water.

The *benzoate* is soluble in alcohol, slowly so in water, and comes in the form of small white crystals.

The *bisulphide* appears in minute

trisnetric prisms, soluble in water and in alcohol.

Iodosulphate of cinchonine is a dark-brown, odorless powder containing 50 per cent. of iodine, and, though sometimes administered internally, it finds its principal use as an external application and substitute for iodoform; it is freely soluble in alcohol and chloroform; slowly soluble in water.

Nitrate of cinchonine appears as colorless prisms, soluble in water; its value is about the same as any other ordinary salt of the alkaloid.

Salicylate of cinchonine, introduced as a remedy for rheumatism, has never equaled the expectations; it comes in white crystals, soluble in alcohol.

Cinchonine sulphate is a fair substitute at times for other cinchona alkaloids; is obtained in hard, white, lustrous crystals of very bitter taste. It is soluble in 10 parts of alcohol, about 65 parts of water, and 75 to 80 of chloroform.

The *tannate* salt is of variable composition, like most tannates; it is an amorphous, yellow powder, by no means constant as to color, slowly soluble in water, and readily so in alcohol.

Cinchonidine is usually obtained from the red cinchona, and may appear either as white prisms, or a white powder, or in light, white masses, and has an intense bitter taste; is soluble in alcohol, ether, and chloroform, in dilute acids, and in water slowly.

Cinchonidine bisulphate is soluble in water and alcohol, and comes in striated prisms. Another salt of no material value is the *borate*: a white powder that is soluble only in alcohol.

The *dihydrobromate*, *hydrochlorate*, and *hydroiodate* salts appear, respectively, as slightly yellowish prisms, white prisms, and yellowish-white crystals; all are

soluble in water, and the hydrochlorate in alcohol and chloroform as well.

The *salicylate of cinchonidine* appears as white colorless microscopical crystals, soluble in alcohol, very slowly so in water.

Cinchonidine sulphate presents white, silky, acicular crystals that effloresce on exposure; is soluble in alcohol and hot water; slowly so in cold water.

The *tannate* is a yellow, amorphous powder, practically tasteless, of uncertain and variable composition.

Cinchonine tartrate, very slowly soluble in water, rapidly so in alcohol, is a white crystal powder.

Quinetum, known also as *chinetum*, *kinetum*, and *cinchona febrifuge*, is a mixture of the alkaloids of red cinchona-bark, devised by East Indian authorities as a better, cheaper, and safer remedy than quinine, and it seems to have met with general favor. In the United States is prepared an elixir of all the cinchona alkaloids that is most palatable, known as "esencia de calasaya," which is intended for the same precise purpose. *Quinetum* is an amorphous, grayish-white powder, containing from 50 to 70 per cent. of cinchonidine; is soluble in dilute acids and slowly so in water. *Quionin* purports to be much the same thing, but is more uncertain as to composition. There is also a neutral *sulphate* of *quinetum* prepared.

Quinidine, *chinidine*, or *conchinine*, has the form of colorless, lustreless prisms, and effloresces on exposure; is soluble, 1 to 20, in alcohol, 1 to 30 in ether, and 1 to 2000 in water. Both a *sulphate* and *bisulphate* are had, the former as white needles, the latter as long, colorless crystals, both being extremely bitter; the sulphate is soluble, 1 to 8, in alcohol, 1 to 14 in chloroform, 1 to 100 in water, while the bisulphate

is soluble (with fluorescence) in water only.

The *dihydrobromate*, *hydrobromate*, and *hydrochlorate* are all white crystal salts, all soluble in water, and the last two also in alcohol.

The *tannate* is an amorphous, tasteless, white powder only partly soluble in alcohol.

Quinoidine, or *chinoidine*, is a mixture of amorphous alkaloids that remain in solution after the crystalline alkaloids have been separated. It is a very bitter, brownish-black mass, lustrous and resinous in appearance, soluble in dilute acids, alcohol, and chloroform, and softens at a temperature of 212° or less. The *borate* and *citrate* appear as yellowish-brown and reddish-brown scales, respectively, and both are soluble in water and alcohol. The *hydrochlorate* and *sulphate* are bitter white powders, alike soluble in alcohol and water. The *tannate* is a yellow or brownish amorphous powder partly soluble in alcohol.

Quinoline, for the most part, is a tertiary amine derived synthetically from aniline, or naturally from coal-tar, though it can also be had from cinchonine. It is a colorless liquid of peculiar odor, that turns yellow with age, and is lauded as an antiseptic; a large number of salts are made, but these are not derived from the cinchonine product, which is five times as expensive as the synthetic or that had from coal-tar.

For description of the quinine alkaloids see QUININE.

Quinic, or *kinic*, *acid* is another derivative of the cinchona-barks, with a decided acid taste, soluble in water and alcohol, and obtained in the form of hard, white, transparent, monoclinic prisms.

Quinolinic acid is no longer had from cinchonine, but from the artificial prod-

uct; and the same is true of the quinosulphuric acids.

Quinopicric acid is a yellowish-brown powder made by mixing quinine and cinchonine picrates.

Quinovic acid is secured from quino-
vin, derived from certain cinchonas. These two, quinidamine, quinquina, quinicine, quinone, and quinotannic acid are obsolete, reclassified, and rearranged, or no longer obtained from cinchona-barks or alkaloids, but as the result of chemical enterprise in connection with aniline and the coal-tar products.

Physiological Action.—The physiological effects of the cinchona-barks and their alkaloids are so inextricably bound up with the action of quinine that they cannot well be separated; therefore only a brief *résumé* can be here given; for more elaborate description, the reader is referred to QUININE.

Cinchona is about fifty times more bulky than its alkaloids, is more astringent, more apt to irritate the stomach, and much more difficult of absorption. Given in sufficient doses, cinchona and its alkaloids are antiperiodic, tonic, febrifuge, and to some degree antiseptic. In small doses no sensible effect is produced, except, perhaps, with the exception of slight arterial excitement, though some, who may be particularly sensitive to the drug, may exhibit an increased flow of animal spirits. Taken in medium doses, just before retiring at night, they sometimes induce sleeplessness. In large or long-continued doses headache may be induced, along with deafness, noises or ringing in the ears, flashings of light across the eyes, vertigo, nausea, and even delirium and coma if pushed to extremes. The supervention of any of these symptoms, called "cinchonism," indicates that the full physiological effects have been produced, and

that no further benefit can be obtained by persevering in administration. The action is much more rapid and energetic when given on an empty stomach, especially after considerable abstinence from food, or when combined with an acid, than when given after meals or in merely a semisoluble state. The drugs, moreover, appear to be—at least in considerable proportion—taken up by the circulation with the result of depriving the blood to greater or less extent of its coagulability; in fact, when the dose is sufficiently large the action is like that of any other poisonous agent. No doubt, the reflex excitability of the cord is diminished on occasions, though this has, in many instances, been denied. Small doses tend to increase the secretion, while large produce a diametrically-opposite effect. Respiration appears not to be influenced. Large doses exhibited during a febrile paroxysm materially depress temperature. The alkaloidal salts may be detected in considerable quantities in the urine in from 30 to 60 minutes after ingestion, but where the bark is exhibited transformation and elimination may be materially delayed. Elimination is usually at its height, in any event, during the third hour; diminishes in twenty-four hours; and ceases about the third day. Although traces of salts may be found in the saliva, perspiration, and the secretions and excretions of the intestines, the bulk of elimination is by the kidneys, and the amount of uric acid in the urine, particularly in malarial poisoning, is apt to be decreased. Most of the salts have an oxytoxic action.

Poisoning by Cinchona.—The fatal dose of any cinchona alkaloid is unknown, and, as regards the bark, it would be difficult to ingest enough to cause fatality, because of the facility with which

the stomach rejects enormous doses. Cinchonism, already mentioned (see **PHYSIOLOGICAL ACTION**), moreover, affords ample warning of untoward effects. A full ounce of quinine has been ingested at a single dose without inducing any very alarming effects, but foreign literature records a case where 5 ounces proved fatal.

The skin of many persons is affected in a peculiar way by the internal administration of the alkaloidal salts; these eruptions may present any of the forms of purpura, roseola, eczema, pemphigus, or even the exanthem of scarlatina.

Case in which, two days after taking 15-drop doses of compound tincture of cinchona, a patient complained of intolerable itching, which was soon followed by vesiculation on the genitals, face, and ears; the whole general surface of the body rapidly became the seat of a scarlatinoid dermatitis. As this began to decline, the palms and soles became affected with blebs, as much as eight ounces of serum being evacuated. The blebs recurred, and it was five or six weeks before recovery was complete, the palms being the last to recover. The same phenomena had before occurred from the administration of quinine. The chief points of interest are the variety of the bulbous manifestations and the great disproportion between the violence of the cutaneous outbreaks and the small amount of the drug ingested. Johnston (Med. Age., Aug. 25, '97).

Therapeutics. — Cinchona - bark no longer receives general employment, partly owing to the large doses demanded, and partly because of the superiority of the alkaloids, either singly or mixed. Once in a great while it finds use in the application of a "cinchona jacket" in the agues of children, the powdered red bark being quilted between two folds of the garment, which is applied next to the skin. Cinchona (red) and snake-root, with spirit of Mindererus is also often employed as a tonic and

stimulant in low forms of fever, typhoid more particularly.

Cinchonine alkaloid is found chiefly in the pale varieties of bark. Its action (and likewise that of its salts), is very similar to that of quinine, but less energetic, and requires to be given in larger doses; it is sometimes substituted for quinine, being cheaper, and when the latter commanded a high price cinchona was often employed as an adulterant.

In intermittent it has an unquestionable, but variable, action; sometimes its action is slow, whatever the dose exhibited, and the paroxysms cease gradually. It is only about two-thirds as active as quinine: a fact that must be considered when prescribing. Again, in doses of 10 to 15 grains it sometimes induces cinchonism, and which it is not usually prudent to exaggerate; further, its therapeutic action is not always proportionate to the physiological effects; for, while it sometimes answers the purpose for which it is prescribed without the latter being manifested, on the other hand, the physiological effects may be most energetic, without any evidence of therapeutic activity. It certainly cannot wholly replace quinine or its salts in severe intermittents or remittents, but may prove a valuable adjunct. The hydrochlorate salt is admittedly the best form for administration, though the sulphate is, perhaps, more generally employed.

Cinchonine appears to act very much in the same way as quinine, but less powerfully; it depresses the heart more than quinine does. (Whitla.)

According to Wood, it is about one-third weaker than quinine, and must be used in correspondingly larger doses.

Cinchonine is recommended as a febrifuge for children because it is nearly tasteless.

The cinchona alkaloids, when swallowed in insoluble form, combine with the acids of the gastric juice and become soluble; so that, as a mere solvent, it is unnecessary to administer cinchonine with acids, and a large dose merely suspended in fluid is quite as efficacious as when dissolved.

Many observers consider that cinchonine is superior to quinine as a prophylactic. This alkaloid passes off in part by the urine, but a portion appears to be consumed in the blood or to be eliminated in some other way.

Cinchonidine is accepted as isomeric with cinchonine, and its alkaloids are used to a small extent as a substitute for the latter and its derivatives, or for quinine salts; like all the derivatives of cinchona, it is toxic and antiperiodic. It is distinguished from cinchonine by its solution being levogyrate, and from quinine and true quinidine by its acid solution not being fluorescent. Cinchonine solutions are dextrogyrate, and its acid solutions are not fluorescent; like cinchonidine, it does not give an emerald-green color with chlorine-water and ammonia like quinine and quinidine.

According to Whitla, cinchonidine resembles both quinine and cinchonine in action, but is less powerful than the first, being about equal to the latter. Like cinchonine, it depresses the heart more than quinine.

Clinical experience has proved the cinchonidine salts to be reliable tonics and antiperiodics. They are said to be eliminated by the kidneys unchanged; also to produce less disagreeable symptoms, both gastric and cerebral, than quinine; but Rafferty, who administered more than three hundred ounces, affirms that it is apt to cause nausea and vomiting. (Wood.)

Quinetum.—This, as before men-

tioned, is known also as "cinchona febrifuge." It is an amorphous, dirty-white powder consisting of mixed alkaloids obtained from the red-cinchona grove at the government plantations, Darjeeling, India; the alkaloids are in the same proportion as found in the bark. The sulphate is a more presentable salt, and resembles quinine sulphate. As the substance known as quinetum consists chiefly of cinchonidine salts (from 50 to 70 per cent.), these latter probably will offer an efficient substitute. Nevertheless, it has almost replaced quinine in India, and is said to be more readily absorbed into the system than the crystalline alkaloids.

It is a well-known fact that the combined alkaloids of the cinchona-bark are much more effective as a tonic than any one of them taken singly. They are to be preferred in combination also, in many instances, as an antiperiodic, particularly when the periodicity of the attack has been in some degree mitigated. It is for this reason that the East Indian Government now provides its officials with "cinchona febrifuge,"—which is merely a combination of cinchona alkaloids—in preference to quinine. While cases are encountered where quinine is practically indispensable for a time, there are few which will not readily yield, and more satisfactorily, to a combination of cinchona alkaloids. *Esencia de calasaya* and cinchona febrifuge are practically identical, save that the former is a fluid medicament, the latter a powder. The *esencia*, moreover, is an ideal general tonic, and is particularly useful in atonic dyspepsia. In the alcohol habit it satisfactorily neutralizes the craving for spirits, and will be found of great service in treating this disease. Wingrave, Lond. (Med. Age, Sept. 25, '93).

Quinidine is believed to have the same action and medical properties as other cinchona salts, and to be equally as efficacious as quinine without giving rise to the disagreeable nervous effects occa-

sionally observed when the latter is given in large doses. Hare says the dose should be double that of quinine, but it would seem preferable not to greatly surpass the dose of quinine.

Quinoidine, or Chinoidine.—There is little to say regarding this substance further than that it partakes of the nature and characteristics of other cinchona preparations. As before remarked, it is a by-product, chiefly a mixture of such alkaloids as are not readily extracted, left after the major portion of the same have been crystallized out. It may be resolved into ordinary quinine, cinchonine, and quinidine alkaloids, but is not generally held a profitable measure. Solutions in either boric or sulphuric acid are employed as cheap febrifuges, but their taste is very nauseous. Quinoidine is neither as certain in composition or uniform in effects as quinetum.

Quinovic, kinovic, or chinovic acid is little employed, as it offers no advantages over other cinchona derivatives: it poses rather as a chemical curiosity than as a medicament.

Cupreine is nearly allied to quinine, and generally on extraction from cuprea-bark found conjoined with the latter: a combination that for a time obtained the title of homoquinine, it being supposed to be a specific alkaloidal entity. Both sulphate and muriate salts are manufactured, but neither the two latter nor the alkaloid—though purported to be equally as efficacious therapeutically as the quinine and its salts—have as yet secured a permanent position in the *materia medica*.

For further consideration of the therapeutics of the cinchonas and their derivatives, the reader is referred to QUININE.

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CINNAMON AND DERIVATIVES.—

Cinnamon is the inner bark of the shoots of the *Cinnamomum Zeylandicum* and *C. aromaticum*: beautiful evergreen trees twenty to thirty feet high and twelve to eighteen inches in diameter, cultivated in many portions of the East Indies. The bark comes in long, closely-rolled quills, composed of eight or more layers; is of pale-yellowish-brown hue, the inner surface striated; fracture splintery; odor fragrant and warmly aromatic, and taste sweet. Some forms are more coarse in taste and odor. Cassia-buds are the calyces surrounding the young germ. The term "cassia" is frequently applied to Chinese and Saigon cinnamon, which is less expensive and more generally marketed in the United States than Ceylon cinnamon.

Preparations and Doses.—Cinnamon-bark (powdered), *ad libitum*.

Cinnamon powder, compound, 10 to 30 grains.

Cinnamon- (cassia) oil, 1 to 3 minims.

Cinnamon extract, fluid, 15 to 30 minims.

Cinnamon infusion, 60 to 120 minims.

Cinnamon tincture, 60 to 180 minims.

Cinnamon tincture, compound, 30 to 120 minims.

Cinnamon spirit (essence), 10 to 30 minims.

Cinnamon syrup, 1 to 2 drachms.

Cinnamon-water, *ad libitum*.

Cinnamic acid, $\frac{1}{4}$ to $\frac{3}{4}$ grain.

Cinnamic aldehyde, not employed medicinally.

Cinnamyl-acetate, not employed.

The compound, or aromatic, powder of cinnamon is made by adding 35 parts of ginger, 15 of cardamom, and 15 of nutmeg, to 35 parts of cinnamon.

Physiological Action.—Cinnamon is a warm aromatic, acting as a true stomachic by a gentle stimulating action on

gastric mucous membrane, increasing its secretion and assisting digestion; hence its general employment as a condiment. It is also hæmostatic, oxytocic, and slightly astringent. The oil and cinnamic acid are also antiseptic, and the acid is claimed to be antituberculous: a claim not altogether satisfactorily substantiated. By some, cinnamon is held to be contra-indicated in all inflammatory states of the gastro-intestinal tract.

Therapeutics.—The scope of the drug is not a very extended one, and it is chiefly employed to render mixtures more palatable.

The eclectics generally regard cinnamon a powerful specific styptic: a claim that appears to be fairly well substantiated by general therapeutic literature. It certainly has, on many occasions, proved most efficacious in epistaxis, hæmoptysis, hæmaturia, and uterine hæmorrhage. In tedious labors dependent upon atony of the uterus and insufficiency of contractions, cinnamon proved quite efficacious in the hands of Mursinna and Thomas Hawkes Tanner.

This drug specifically influences the uterus, controlling hæmorrhage and stimulating contraction of its muscular fibres. In small and repeated doses it is capable of producing abortion; hence it is indisputable that it exerts a powerful influence on the nutritive functions of the womb. It is possible that more study and experimentation will reveal the drug to be possessed of further remedial virtues. Webster ("Dynam. Therap.," '93).

It acts upon the uterus like, though much less powerfully than, ergot, and probably also on the smooth muscular tissue in general—and as a styptic and astringent. It is employed, therefore, as an adjuvant to remedies for diarrhœa; in the second, non-febrile stage of acute intestinal catarrh; and in torpidity and slight hæmorrhages of the uterus, usually in combination with ergot. Roth ("Mod. Mat. Med.," '95).

Though used as an aromatic, its chief use is to control uterine hæmorrhage, and it acts promptly by contracting the bleeding vessels; it is also of considerable value in some forms of diarrhœa. Locke ("Mat. Med. and Therap.," '95).

Thirty cases of dysentery were permanently relieved by employing from one to six doses of the Persian remedy: a drachm of powdered cinnamon made into a bolus with a few drops of water and swallowed with as little fluid as possible. Avetoom (Lancet, Lond., vol. i, Mar., '95).

AS AN ANTISEPTIC.—Cinnamon, cinnamic acid, cinnamic aldehyde, and the oil of cinnamon doubtless possess antiseptic power, and may be advantageously used in the treatment of purulent foci and necrotic processes. It is owing to this property that it has occasionally proved of some value in pulmonary tuberculosis.

No living disease-germ can resist for more than a few hours the antiseptic power of essence of cinnamon; even its scent will kill them. The essence is as effective as corrosive sublimate. An infusion of cinnamon is valuable in influenza, typhoid fever, and cholera. Chamberland (Med. Age, Apr. 25, '94).

Cinnamic aldehyde, or cinnamic acid, has recently been employed as an antiseptic in the various forms of tuberculosis, with encouraging results. Stevens ("Man. of Therap.," '94).

The oil of cinnamon is powerfully antiseptic and may be used in dilute form in the dressing of wounds, and by injection in gonorrhœa; in the latter disease it acts best in the early stage. Cinnamic acid is also used for the same purpose. Hare ("Prac. Therap.," '94).

A solution of 1 part of cinnamic acid in from 10 to 20 parts of glycerin proves an excellent remedy in tuberculosis, particularly of joint-cavities; it may be injected into the joint, into the fungous mass, or into the gluteal muscles. Likewise it may be employed in pulmonary and intestinal tuberculosis. Leucocytosis begins in from an hour and a half to two hours after the injection, and reaches the

maximum in eight hours. The leucocytes are increased, and there is no decrease in the red corpuscles or the hæmoglobin. Landerer (Therap. Monats., Feb., '94).

It is probable that oil of cinnamon cures consumption in two ways: In the early stage of catarrhal phthisis by so directly affecting the bacilli as to stop their growth; in cases farther advanced by only allowing organisms incapable of growth to pass along the bronchi, and thus prevent the infection of fresh lobules. In this way the disease may be limited to small areas, where it can be dealt with by the vital processes of the body, and cut off from the system by the formation of fibrous tissue, and so cease to be an immediate source of danger. It is interesting to observe the order in which the symptoms subside: The expectoration and cough are the first to improve; then the temperature tends toward the normal; finally the weight begins to increase; and all these are accompanied by gradual diminution in the number of the bacilli in the sputum. Thompson (Brit. Med. Jour., vol. ii, '97).

In advanced cases of phthisis personal results with cinnamic acid were distinctly unfavorable. In 12 cases not so far advanced, treated intravenously, for periods of from five to seven weeks, 3 died, 1 became worse, 3 remained in much the same condition, and 5 were but slightly improved. Laryngeal complications were not benefited by the treatment. Hæmoptysis seemed to be rendered worse. F. Fränkel (Deutsche Archiv f. klin. Med., lxx, pts. 5 and 6, 1900).

FEBRILE DISEASES.—In low stages of fever, and where there is persistent nausea and vomiting, some of the cinnamon preparations appear absolutely magical in effect, but the causes of the latter condition are so varied, and fevers so protean in their aspects, that no one remedy can be relied upon on all occasions.

It has been recommended in malarial diseases, but, at best, it can only be considered as a *succedaneum*.

CIRRHOSIS OF THE LIVER.

Definition.—Suggested by Laennec as a name for one particular condition of the liver, the term “cirrhosis” was not only found to be of immediate utility, but, like many other useful words, has rapidly acquired secondary meanings, and unfortunately the pathologist and the clinician disagree in the secondary meaning which they assign to the term. Hence a definition of “cirrhosis” satisfactory to all parties cannot well be given. In short, the word, by becoming too useful, threatens to outlive its usefulness. The pathologist employs it to indicate all those conditions in which there is a generalized, as opposed to localized or focal, development of increased amounts of fibrous tissue in the organ; the clinician recognizes as included in the term all those conditions characterized by connective-tissue overgrowth in connection with the liver, whether the overgrowth be focal or general, whether it affect the interior of the organ or the peritoneal capsule, and urges in favor of this view that all these conditions may give rise to a like series of symptoms; while, on the other hand, he is unwilling to include under the terms such forms of connective-tissue overgrowth as give rise to no recognizable symptoms. According to this view, the gummatous liver of tertiary syphilis is cirrhotic, as is also the condition of chronic productive perihepatitis in which the capsule alone is affected, while the development of fibrous tissue in the centres of the lobules which may accompany chronic venous congestion of the organ is not to be classed as a cirrhosis.

Remembering that Laennec employed the word in association with a generalized fibrosis of the organ, and not to indicate the complex of symptoms induced by this condition, and recognizing, also,

that it is impossible to restrict it nowadays to the one form which he described, the definition accepted by the pathologists more nearly approaches the original acceptation of the term, and will be adhered to in this article. At the same time, adequate reference will be made to such conditions as are not included in that definition, but which are regarded as cirrhosis by a large number of clinicians.

Classification.—Starting, then, with this definition, and including under the term all those states in which there is a generalized overdevelopment of connective tissue throughout the liver, it will be well, before attempting any classification, to pass in review the factors which primarily induce this overgrowth.

Our knowledge of the causes leading to fibrosis elsewhere, imperfect as it is, leads to the belief that inflammation is the main factor,—not acute, but, as it is termed, “productive.” It may be brought about by the action of a mild irritant extending over a relatively-long period, or by the recurrent action of a somewhat more severe irritant. In either case there is a stimulus afforded to the proliferation of the connective-tissue cells of the part—and the new growth corresponds to the granulation-tissue seen in a healing exposed wound. A prominent feature in fibroid tissue of this nature is its liability to contract. It would appear that in the commonest form of cirrhosis, the portal, or atrophic, this is the main process at work, the irritant reaching the liver by the portal vein and especially manifesting its activity by setting up an irritation along the interlobular branches of that vein.

This, however, is not the only form of inflammatory fibrosis. There may be a new development of connective tissue—a *replacement* fibrosis—to take the place

of cells of a higher order, which, through the action of some irritant or disturbance, have undergone destruction, and it is still a matter of debate whether, in portal cirrhosis even, such replacement-fibrosis is not largely concerned in the new growth. Of more recent observers Sieveking, examining twenty atrophic cirrhotic livers by the Van Gieson method of staining, concluded that the connective-tissue growth was the first disturbance. Markwald came to the opposite conclusion: that necrosis of the peripheral liver-cells is the first event in the disease; and Ruppert describes both productive formation of connective tissues and inflammatory atrophy of the liver-cells. Personally I cannot but regard this last view as the one most in harmony with the appearances seen in the majority of cases of well-defined portal cirrhosis.

In one form of cirrhosis,—the pericellular or interstitial,—of which in man the liver of congenital syphilis affords the best example,—replacement-fibrosis is the distinguishing feature. In this the various stages of cellular atrophy can be well followed, and the little groups of cells are to be seen surrounded by delicate new tissues of a character very different from that of the dense connective bands seen in portal cirrhosis. The difference makes itself evidenced by the gross appearance of the organ, for this form of fibrous tissue does not contract, the surface remains smooth, and the organ is enlarged instead of being diminished in size. It may be urged that this enlargement is a proof of the productive character of the process, but the enlargement appears to be due, in the main, to a lack of pressure-atrophy of the hepatic parenchyma so characteristic of portal cirrhosis, coupled with a compensatory proliferation of the liver-cells

to replace those which have been destroyed. A proliferation or hypertrophy of this nature is occasionally well marked in the portal form, resulting in the formation of islands of new liver-tissue and the production of a large hobnailed liver. Rarely the new growth of the parenchyma advances to an adenomatous or even cancerous condition, and we meet with a greatly-enlarged irregular cirrhotic liver with multiple neoplastic masses derived from the liver-cells.

If this process be the explanation of the hypertrophied liver of pericellular cirrhosis, then the appearances in biliary cirrhosis proper present macroscopically and microscopically so many points of approximation to what has just been described, that the fibroid overgrowth here may well be largely of the nature of a replacement-fibrosis. The tendency is for recent observers to regard it as such, and to consider that biliary cirrhosis of the type which has especially been studied by Hanot is a cholangitis in which either the bile-capillaries within the lobule, or the cells bordering upon these, are especially affected. These liver-cells undergo gradual atrophy and replacement by new connective tissue. Goluboff regards this form as being primarily due to the chronic, diffuse, catarrhal angiocholitis with chronic, diffuse periangiocholitis. Now, a catarrhal angiocholitis affecting the smallest bile-ducts affects the capillaries also, and is inevitably a process affecting the liver-cells themselves. But, while accepting these views with regard to the main characteristics of the fibroid changes of these two important forms of cirrhosis, it must, I think, be admitted that, save in relatively-rare instances, the organs affected by one or other form of the disease show a mixture of both productive and replacement changes.

There are yet other ways in which fibroid tissues may be developed in various organs without recognizable inflammatory disturbance, and, as I have pointed out in the Middleton Goldsmith Lectures (1896), there may be increased development of fibrous tissue of a functional type. Such fibrosis is to be recognized in connection with altered conditions of the arterial, venous, and lymphatic circulation. It is difficult to say how far such forms manifest themselves in the liver. On the whole, the evidence is against there being any extensive development of new connective tissue in the organ from such a cause; but it may well be that the indurative form of passive congestion of the organ and the growth of fibrous tissue around the interlobular branches of the hepatic vein, in cases where there is long-continued obstruction of moderate degree brought about by either heart or lung disease, are to be regarded as due to a laying down of new connective tissue around the hepatic venules of non-inflammatory origin.

It is evident that, inasmuch as our definition is based upon the one condition of overdevelopment of fibrous tissue in the organ, a proper classification of the various forms of cirrhosis cannot be based primarily or adequately upon the disturbances occurring in other parts of the body as secondary results of the hepatic fibrosis, but must be either etiological and made dependent upon the various causes leading to the development of fibrous tissue or, on the other hand, must—anatomically—be determined by the parts of the liver which are the primary seat of the development of the new tissue. Our knowledge of these cirrhoses is still insufficient for either the etiological or the anatomical classification to be ideally perfect. Against the etiological classification it may be objected

that we are still uncertain as to how far the commonest form—portal cirrhosis—is due to the direct action of alcohol, how far it is due to the absorption of toxic substances from the intestinal canal secondary to the gastritis and enteritis induced by alcohol; nor again does the mere enumeration of causes help us in every case to distinguish the special type of cirrhosis which those causes induce, and so, the symptoms depending upon the form of hepatic disturbance, such a classification can be of little clinical value.

On the other hand, the anatomical classification is imperfect to the extent that, while the disease may begin by affecting one special portion of the liver, as the process of fibrous-tissue development extends, it involves many other parts, and, consequently, in well-developed cases cirrhosis is anatomically of a mixed type, and it is far from easy in such cases to determine how the condition originated. The fullest etiological classification is that given by Chauffard, and this has, at the same time, the advantage of being anatomical. He divides the cirrhoses as follows:—

1. VASCULAR (originating around the vessels).

- (A) TOXIC { 1. Due to ingested poisons.
2. Due to autochthonous poisons.
- (B) INFECTIOUS { 1. By the direct action of microbes. { (a) Local.
2. By their indirect action through their toxins (or, as he terms it, tox-infection). { (b) Extra-hepatic.
- (C) DYSTROPHIC { 1. Arteriosclerotic.
2. Congestive.

2. BILIARY.

- (A) DUE TO BILIARY RETENTION.
- (B) DUE TO ANGIOCHOLITIS OF THE SMALLER BILE-DUCTS.

3. CAPSULAR.

- (A) CHRONIC LOCALIZED PERIHEPATITIS.
- (B) CHRONIC GENERALIZED PERITONITIS.

Admirable as is this classification, it

is difficult to see how we are to make the distinction which is here made between the toxic cirrhosis and the toxi-infective. Anatomically and clinically, poisons—whether absorbed from the stomach or developed in the system itself, or again passing into the blood as a result of the growth of micro-organisms, or again given off by micro-organisms within the liver itself—may produce similar lesions in the liver, and as a consequence bring about closely allied, if not identical, anatomical changes in the organ with the development of like symptoms. The distinction thus raised by Chauffard between these various forms is too fine for practical use; clinically, his subdivisions are almost valueless; hence, in this article, I have divided the cirrhoses according to anatomical grounds alone, and shall recognize the following forms of cirrhosis according to the origin of the process:—

1. **PORTAL CIRRHOSIS**, in which the process appears to begin especially around the branches of the portal vein.

2. **BILIARY CIRRHOSIS**.—(a) In which the process manifests itself around the larger bile-ducts. (b) In which the process more especially shows itself around the smallest bile-ducts and in connection with the bile-capillaries.

3. **PERICELLULAR CIRRHOSIS**, characterized by the development of fibrous tissue throughout the lobule around the individual cells and groups of cells.

4. **ARTERIAL CIRRHOSIS**, in which are chronic periarteritis and development of fibrous tissue around the arteries.

5. **CENTRILOBULAR CIRRHOSIS**, characterized by the development of fibrous tissue around the interlobular branches of the hepatic vein.

6. **SECONDARY, OR CENTRIPETAL, CIRRHOSIS**, due to the extension inward of

a chronic fibroid inflammation secondary to chronic productive perihepatitis.

7. **SPORADIC CIRRHOSIS**, secondary to focal necroses scattered through the organ or to the development of inflammatory foci in no one well defined portion of the liver-tissue, which act as centres from which there radiates a fibroid change.

Of these different forms it must be repeated that all are not clinically recognizable and that it must be clearly borne in mind that a change beginning in one anatomical region of the organ is, by its extension, peculiarly liable to affect other regions. I will now proceed to consider these various forms, calling attention to those which are clinically important and those which are, up to the present time, clinically unrecognizable.

Portal Cirrhosis.

Etiology.—This form of cirrhosis is most frequently associated with alcoholism, more especially with the use of spirits, and as a consequence has become known in England as the gin-drinker's liver. At the same time a small proportion of cases is met with in which there is an entire absence of the alcoholic history.

Upon this continent all other causes are insignificant when compared with the one prime cause of excessive and long-continued use of alcohol.

While this is the case and while alcohol must be regarded as a prime cause, much evidence has accumulated of late years to throw doubt upon alcohol as the primary cause. As Payne has pointed out, cirrhosis of the liver is the exception and not the rule in autopsies upon drunkards; the fatty, and not the cirrhotic, liver is typical of alcoholism. Besides this, the experiments of a large number of observers have failed to demonstrate that ethylic and not amylic alcohol

is capable of producing any marked development of cirrhosis in the livers of rabbits, dogs, pigs, or rats. In fact, only three observers, Straus and Blocq in the rabbit, and de Rechter in the dog and rabbit, have observed such cirrhotic changes. Magnan, Ruge, Pupier Nairet, Combemale, Strassmann, Afanassijew, von Kahlden, Lafitte, and Kerr have found almost entire absence of portal inflammation, but have noticed more or less extensive fatty infiltration and fatty degeneration.

It may be urged that these observers did not preserve their animals for a sufficient length of time; nevertheless, several of the observers kept their animals for several months, and, were alcohol the direct cause of the disease, there should undoubtedly have been more evidence of, at the least, a beginning inflammation in the portal sheaths around the lobules.

Importance of alcohol is much over-rated in the etiology of cirrhosis of the liver. Rosenstein (*Brit. Med. Jour.*, Oct. 1, '98).

Alcohol, in the main, leads to fatty liver, while, on the other hand, the evidence has steadily accumulated, notably in India, that extreme cirrhosis may attack children and adults who have never taken a particle of alcohol either medicinally or otherwise. J. George Adami (*Lancet*, Aug. 13, '98).

To ascertain what influence alcohol had as a cause of hobnailed liver the records of 2020 necropsies made at the Middlesex Hospital were examined; of these, 149 were cases of cirrhosis of the liver, which was hobnailed in 36. Of the 36 cases, alcoholism was acknowledged in 15, denied in 9, and not noted in 15. Of 4278 necropsies made on children under 12 years of age at Great Ormond Street, there were 23 cases, and hobnailing was present in 13. Conclusions are that alcohol plays an important part in the production of cirrhosis, but in what

way is uncertain. Arthur Voelcker (*Brit. Med. Jour.*, Sept. 29, 1900).

This discrepancy between the experimental results and the history given in man of alcoholism is to be explained in two ways: Either it must be admitted that alcoholism is the primary factor in cirrhosis, in which case it has to be acknowledged that individual predisposition plays a part of almost equal importance; so that cirrhosis is to be described as being due to the fibrotic or cirrhotic diathesis manifesting itself under the influence of alcohol. Or, on the other hand, we must regard alcohol purely as a predisposing cause, and must pass beyond the alcoholism and admit that, at most, alcohol causes irritation and inflammation of the gastric intestinal mucosa, whereby either toxic substances pass into the portal blood from the intestines (and regard these toxic substances as the direct cause of the inflammatory condition of the organ), or it is possible to go further and regard the inflammation as set up by some form of micro-organism entering the liver along the same paths. Upon the whole, the toxic, as opposed to the direct alcoholic, view would appear to be the more correct.

All recent work appears to be leading to the conclusion that portal cirrhosis of the liver is brought about by a condition of toxicæmia. Of special interest in this connection is the observation of Flexner, who found that by injecting a 1-per-cent. solution of dogs' serum, which had been kept for twenty-four hours, into the vein of a rabbit, the animal showed almost immediate evidences of profound blood disturbance in the shape of hæmoglobinuria, and in a week began to lose weight, and, dying at the end of the second week, presented in its liver most marked evidences of beginning portal cirrhosis.

This view that cirrhosis is the result of an intoxication following gastro-intestinal disturbance is that held by Hanot and the majority of recent French workers.

[Lévi has gone so far as to suggest that the condition may be set up directly by bacteria. In a case of a young male of 17, in whom he found periportal cirrhosis and greatly enlarged spleen, with, in addition, bacterial endocarditis of the pulmonary valve, albuminuria, and suppurative meningitis, he discovered a diplococcus pathogenic in guinea-pigs. From his description, the cirrhosis was of a rather mixed type, for, along with the rich connective-tissue overgrowth, there was well-marked proliferation of bile-canalliculi directly connected with the liver-cells. The condition lasted for fifty-one days, and, while it is possible that such extensive cirrhotic changes might have been produced in this time, the other lesions make it doubtful whether he was dealing with a condition of cirrhosis directly due to the micro-organism; certainly it cannot be said that the case is one of ordinary cirrhosis. J. GEORGE ADAMI.]

The following facts are recorded in regard to cirrhosis of the liver: 1. That in at least a very large number of well-marked cases of progressive cirrhosis in man there is to be found, largely within the liver-cells and also in the lymph-spaces in the newly-formed connective tissue, a peculiar and very minute form of micro-organism, presenting on staining to the proper extent the form of a diplococcus, surrounded by a faint halo, or, when stained deeply, being a rather obscure ovoid bacterium, which may easily be mistaken for stained deposits within the cells. 2. That in the infective cirrhosis of cattle a very similar micro-organism is recognizable, present in like positions within the tissues and showing similar appearances when stained. 3. That from at least thirty cattle affected with this disease the author has been able to isolate the micro-organism from the liver-bile, abdominal lymph-glands, and in some cases from the various organs in

the body. 4. That the micro-organism isolated from these cattle is a polymorphous micro-organism, appearing as a small diplococcus when grown upon broth, and tends to assume a distinctly bacillary form when grown on solid media. 5. That this micro-organism is pathogenic for the animals of the laboratory, and that in them it is to be recognized within the hepatic cells as in other regions. 6. That from a case of distinct atrophic cirrhosis in the human being the author has been able to isolate from various organs of the body a similar micro-organism, which, grown on broth, has a diplococcic form and grown upon agar is present as a short or longer bacillus according to the age of growth. The author does not believe that the micro-organism causes only cirrhosis, and suggests that it may be the cause of more than one disturbance in the liver,—indeed, in other organs. J. George Adami (Lancet, Aug. 13, '98).

On the other hand, the not-infrequent presence of inflammation surrounding the atrophic liver and the frequent presence of a right-sided pleurisy (which is suggestive of an extension of the inflammatory process through the diaphragm into the pleural cavity) make it not impossible that some cases, at least, of portal cirrhosis are due to something beyond the action of toxins and irritants conveyed by the blood, and makes it probable that some cases are associated with the presence of definite bacteria.

Besides these toxins, whether elaborated in the intestinal canal and absorbed, or due to the growth in the system of bacteria, other poisonous substances may lead to the developing of cirrhosis.

Of such absorbed toxins it has been suggested by Budd that the frequent cirrhosis found in the natives of India, who never partake of alcohol, is secondary to the irritation and gastritis produced by highly-seasoned foods; and Segers describes an atrophic form in the Terra

del Fuegians brought about by eating mussels. He obtained from these mussels a poison which was definitely toxic for dogs and rabbits. Such cirrhosis is not infrequent in lead poisoning, and Lafitte states that, giving lead to rabbits with their food, he induced a cirrhotic condition in their livers. Eichhorst's case of nodular cirrhosis due to chronic phosphorus poisoning would come under the same category.

Cirrhosis of the liver manifested among the Fuegians, who eat from 12 to 25 pounds of mussels daily, whether good or bad. The mussels are toxic only at a certain period of their development; the toxic effect is not due to microbes, but to some chemical product. Chronic mussel poisoning is curable up to a certain point, when it is manifested only by enlargement of the liver. When it has arrived at its second period, that of atrophic cirrhosis, it is rapidly fatal. Segers (La Sem. Méd., Nov. 4, '91).

All these are cases of disease possessing a similar character, namely: characterized by the development of the inflammatory new tissue in the portal sheaths and more especially around the branches of the portal vein. For the present time I leave out of account the other forms of cirrhosis which are of a different type brought about by other toxic agents and the consequent development of inflammatory foci or focal necroses irregularly scattered through the liver-substance.

Neither drugs,—*e.g.*, alcohol, phosphorus, etc.,—nor embolism of the portal vein, nor ligature of the hepatic artery or bile-duct, or other operative procedure, nor acute yellow atrophy, nor long-standing venous congestion, can produce a true hepatic cirrhosis. One or other of these causes might result in cellular degeneration or necrosis. Such necrotic foci might come to be encapsulated by fibrous tissue, but this is not a cirrhosis, which, in the proper sense of the term, is a progressively-advanc-

ing interstitial hepatitis. The same objection obtains as regards the interstitial changes which are seen passing inward from the capsule as a sequel to long-standing and progressive cases of fibrous perihepatitis. There is marked difference between the cirrhotic changes that follow upon parenchymatous degeneration and the true classical interstitial hepatitis, which arises as a primary condition. Siegenbeek von Heukelom (Zeigler's Beiträge, B. 20, H. 2, No. 221, '96).

In venous cirrhosis of the liver, without any lesion of the biliary apparatus or of the pancreas, the insufficient emulsification of the fats points to a disturbance in the functions of the liver, while the ureogenic, biligenic, glycogenic, and antitoxic functions of the liver are not yet disturbed. Luigi Ferranini (Riforma Medica, Oct. 31, 1900).

AGE AND SEX.—With regard to sex, the condition affects males more than twice as frequently as it does females; indeed, some authorities would make it as much as three times more frequent in males. From the more recent statistics of Rolleston and Fenton, and of Kelynack, it would appear that the most common age at which death occurs is between 40 and 50; two-thirds of the fatal cases occur between 35 and 50. Rolleston gives the average age in males having an alcoholic history as 48, without alcoholic history, 49, and in females 46 and 51, respectively. Kelynack gives the average of his 121 cases as: males, 45½; females, 42. But the condition may develop at almost any period of life; numerous cases have now been brought forward in children since Palmer Howard published his classical article on this subject.

Pathology.—In alcoholics, in whom the condition most frequently develops, the liver is, at first, large, owing to the fatty infiltration and hepatic congestion, both of which are the direct result of alcoholism. In what is taken to be the earliest stage there is observable an ab-

normal collection of small, round cells infiltrating the portal sheaths and causing them to stand out prominently in the stained sections, the greatest accumulation being in the neighborhood of the vessels running in those perilobular sheaths. These small cells have rounded, and not polymorphous, nuclei, and are generally regarded as being, in the main, embryonic, connective-tissue cells. In somewhat more advanced conditions the sheaths have undergone definite enlargement and are formed of dense, fibrous tissue, although there is still an abundant infiltration of small, round cells more especially at the margins where they abutt upon the lobular parenchyma. Just as at the beginning the infiltration is not evenly distributed around the lobules, so in more advanced conditions the development of fibrous tissue is not even, and as a consequence the newly-formed bands of fibrous tissue tend to surround many lobules; the fibrosis is what is termed *multilobular*. As this inflammatory new connective tissue reaches maturity, it contracts and by its shrinkage is produced the nodular and hob-nailed surface of the organ. In regions or cases in which this process of connective-tissue formation has reached its limit or is not progressing, the new bands are sharply defined from the included parenchyma of the organ; where it is continuing to advance there is not the same sharp separation; small groups of liver-cells at the periphery of the lobules may be seen more or less surrounded by strands of newly-forming fibrous tissue and exhibiting well-marked signs of atrophy.

There is still much debate as to whether of necessity the first stage of portal cirrhosis is characterized by enlargement of the organ, and some recent writers, including Osler, would draw a

distinction between the ordinary atrophic and the fatty cirrhotic liver. It is true that patients may die of intercurrent disease when the liver is still enlarged and fatty, and that, on the other hand, patients may only exhibit symptoms of cirrhosis when the organ is already so contracted as to be scarcely, if at all, palpable. But, taking into consideration the direct effects of alcoholism and calling to mind three or four cases in which, by good fortune, careful notes of the size of the liver were taken during the months preceding symptoms of portal obstruction, I cannot but uphold the view that portal cirrhosis (where associated with alcohol) has a preliminary stage of hepatic enlargement. Where alcoholism is not intimately connected with the development of the condition there, such preliminary enlargement may not, of necessity, form a stage in the development of the condition.

Study of 37 fatal cases of cirrhosis of the liver. Cirrhosis with enlargement, without change in size, and with diminution in size are equally frequent. The size of the liver is increased in one-third of the cases. The male sex is more frequently affected. Cirrhosis with enlargement is more common in younger people, and cirrhosis with atrophy in old. The average duration of symptoms is longer in the atrophic cases. The duration of symptoms, however, varies within wide limits in all varieties. Hæmorrhage is a not-infrequent cause of death in all forms, and a fatal hæmorrhage may be the first symptom, even in the hypertrophic form. An alcoholic history was obtained in every case in which the subject was investigated. A history of previous malaria, syphilis, or gall-stones was occasionally obtained, but in none did it seem of etiological importance. Morse (Boston Med. and Surg. Jour., Mar. 10, '98).

In ordinary or atrophic hepatic cirrhosis the pancreas is enlarged, though the head and body are relatively smaller

than the tail. The enlargement is due to well-formed fibrous tissue, cirrhosis of the liver radiating out from the blood-vessels. The gland-cells undergo fatty and pigmentary degeneration. The areas of cells, Langherans's islands, share in the pigmentary change.

In hypertrophic biliary (or Hanot's) cirrhosis the pancreas is not increased in size or in weight, but shows a very intimate fibrosis of an embryonic type spreading out from the ducts of the gland. There is periductular fibrosis and a little proliferation of the epithelium lining the ducts. The gland-cells show fatty degeneration. In cardiac hepatic cirrhosis the condition of the pancreas is inconstant. Lefas (*Archiv Génér. de Méd.*, May, 1900).

It is remarkable how extreme may be the atrophy of the organ as a result of this fibroid contraction. Cases are on record in which in place of the normal 50 to 60 ounces (1500 to 1800 grammes), the organ has weighed from 16 to 10 ounces and even less, and notwithstanding this the main symptoms of the disease may not be referable to the diminished activity of the organ so much as to the secondary disturbances of the portal circulation. Despite the great development of contracting fibrous tissue around the lobules, bile may yet find its way from the bile-capillaries into the bile-ducts, and the fibrous bands, instead of appearing to be anæmic, appear to possess abundant blood-capillaries. Obstruction there is to the portal circulation, and yet these capillaries can be easily injected from the portal vein; so that it is not necessary to assume, as some have done, that the blood-supply of the liver in this form of cirrhosis is, in the main, conveyed by the branches of the hepatic artery. As a result of the process, the organ is dense, firm, and of almost leathery consistence, presenting, on section, minute islands of reddish-yellow parenchyma of varying size

surrounded by the more glistening bands of connective tissue. If the condition be complicated with jaundice, then the islands of liver-tissue more especially are tinged by the bile-pigment; if with hæmochromatosis (pigmental cirrhosis), both fibrous and liver-tissue may show a darker, slaty tinge; if the liver-cells still retain a fair amount of fat the islands of parenchyma appear of a paler yellow; if the process has been of more acute development, then with the fibrosis there may be inflammatory congestion, and the organ, in general, have a reddish appearance.

In general, the left lobe is more affected and more shrunken than the right; sometimes it is singularly small,—a mere appendage to the larger right lobe; but this is not constantly the case, and the opposite may occur. It must be kept in mind that the right lobe may be contracted behind the ribs and the left still be prominent: a condition which has more than once led to the mistaken diagnosis of hepatic or pancreatic tumor.

Varieties of Portal Cirrhosis.—Thus far I have treated of portal cirrhosis in general, but it must be recognized that there are several varieties and stages in which the condition may manifest itself. The unfortunate employment of the term "atrophic" has led to not a little confusion and failure to recognize that these several varieties are but manifestations of one and the same process.

It may, in the first place, be questioned whether the disease always presents the same slow rate of development. Apparently this is not the case; we may have either acute or chronic cirrhosis. The London school of pathologists is inclined to recognize the red atrophic liver, characterized by the presence of large islands of yellow, fattily-degenerated paren-

chyma surrounded by greatly-reddened congested tissue, which, under the microscope, shows abundant signs of a sub-acute productive inflammatory condition, with leucocytic infiltration and the development of new connective tissue. It is still a matter of a little doubt as to whether this condition is truly a portal cirrhosis.

The cases brought forward by Cayley and Carrington and others all appear to be of this nature. There is a history of excessive indulgence in alcoholism, of preliminary slight gastric disturbance with signs of epigastric oppression, contraction of the liver, and development of ascites accompanied by more or less jaundice. The gross appearance of the liver is not greatly unlike that of acute yellow atrophy; but death takes place not in a few days or weeks, but in two or three months after the first symptoms are complained of.

Cases of acute yellow atrophy of the liver which are not rapidly fatal develop into typical examples of cirrhosis of the liver. Von Kahlden (*Münchener med. Woch.*, Oct. 5, '97).

On the whole, therefore, I am inclined to classify this red atrophy as an acute condition of portal cirrhosis.

As will be readily understood, the vast majority of cases are, in the nature of things, chronic.

Thus, to classify the different varieties:—

(A) ACUTE: RED ATROPHY OF THE LIVER.

This condition has just been referred to.

(B) CHRONIC: 1. ENLARGED FATTY CIRRHOTIC LIVER.

The organ in this condition is markedly enlarged, shows but slight nodulation, and microscopically presents a not-far-advanced condition of cirrhosis. In a large number of cases it is unaccom-

panied by ascites, although the spleen may be enlarged; it occurs essentially in alcoholics and may not be recognized until after death from some intercurrent disease.

2. THE ATROPHIC HOBNAILED LIVER.

—The characteristic form of the disease. The organ greatly reduced in size, with surface studded with nodules of varying size, generally small; very dense and leathery; generally accompanied by marked ascites and other evidences of portal obstruction, and enlarged spleen. On section, of yellowish-red color, showing well-developed, glistening bands of fibrous tissue separating off small islands of the parenchyma.

3. PORTAL CIRRHOSIS WITH SECONDARY PARENCHYMATOUS HYPERTROPHY.

—The hypertrophic, alcoholic cirrhosis of French writers. The organ larger than, but similar in character to, the preceding form. There is a considerable amount of confusion about this form, owing to the use of the term "hypertrophic." It has often been confused with the biliary cirrhosis of the type studied more especially by Hanot; while, again, others confound with this the intermediate stage between the enlarged fatty cirrhotic liver and the small atrophic organ, and again cases of mixed biliary and portal cirrhosis. In the true hypertrophic cirrhosis of this type the organ presents a nodular surface, some of the nodules being of a relatively-large size. The weight is normal or above the normal, and the enlarged size appears to be due, in the main, to compensatory overgrowth of some of the isolated lobular masses and to a partial recovery of the organ from the effect of the cirrhosis.

4. PORTAL CIRRHOSIS WITH ADENOMATOUS OR ADENOCARCINOMATOUS OVERGROWTH.—The distinction between the last condition of cirrhosis with parenchy-

matous hypertrophy and cirrhosis with generalized adenomatous condition is very subtle, and, as shown in connection with Fussell and Kelly's first case (*Trans. Assoc. Amer. Physic.*, vol. x, p. 116, '95), good authorities may differ as to whether a liver presents the one or the other condition. On the other hand, there may be such extensive overgrowth and multiple formation of large neoplastic masses, that there can be no doubt as to the cancerous nature.

[Kelch and Kiener (*Arch. der Physiol.*, p. 622, '76), who first called attention to the condition, regarded the cirrhosis as secondary to the overgrowth. In this probably they are in error. Several examples of this adenomatous condition, and of the carcinomatous, have been described by Paul (*Trans. Path. Soc.*, London, xxxvi, p. 238, '85), Hanot and Gilbert (*Etudes sur les Malades du Foie*, '88), Adami and Finley, Fussell and Kelly, Rohwetter, Saburin, Kelyneck (*Edinburgh Med. Jour.*, p. 187, '97), and others. J. GEORGE ADAMI.]

In the majority of these cases the cirrhosis seems to be of the mixed kind, being multilobular and at the same time presenting abundant formation of new bile-canaliculi: an indication that possibly the following form is not truly a mixed portal and biliary cirrhosis, but a portal cirrhosis with parenchymatous hypertrophy, one of the indications of their hypertrophy being a proliferation of the bile-canaliculi.

5. MIXED CIRRHOSIS.—A very large number of cases must anatomically be classed under the heading of mixed cirrhosis, though the gross appearance of the organ and the clinical history bring them definitely into the category of portal cirrhosis. The condition is, in the main, multilobular, but there is abundant formation of new bile-canaliculi. The organ, again, in general, approximates to the normal size, and there

is not the extreme atrophy seen in the uncomplicated cirrhosis.

6. PORTAL CIRRHOSIS WITH PIGMENTATION.—It is well known that normally the liver contains a certain amount of iron. Lindemann (*Ctbl. f. Allgem. Pathol.*, vol. viii, '97) finds that this iron in the slightest grades exists only in the cells of the portal tissue; when more extensive, there is deposit of the iron-pigment in the capillary-walls, and Kuffer's cells are affected; in the highest grade of anæmia the pigment is in the liver-cells at the periphery of the acini. This pigment is, in general, of a brownish or ochrous tint, and, though Auscher and Lopicque (*Soc. Méd. des Hôp.*, Feb. 12, '97) speak of it as a form of hydrated iron, it is, perhaps, more truly an iron albuminate. Within the last few years, Letulle, Hanot and Schuhmann, Gilbert, and Grenet have described several cases of pigmentary cirrhosis, occurring in general in association with the hypertrophic type of the disease: *i.e.*, with either mixed cirrhosis or portal cirrhosis with parenchymatous hypertrophy. In these cases the livers contain increased amounts of iron. In a recent case of this nature observed by me the liver was of normal weight, but diminished in size and markedly atrophic, showing this iron everywhere, not only in the portal spaces, but present in large amounts in the cells right to the very centre of the hepatic lobules. The Germans are inclined to consider these cases as examples of cirrhosis complicated with the condition which von Recklinghausen has denominated "hæmochromatosis": a condition of which a full account will be found in Hintze's paper (*Virchow's Archiv*, vol. cxxxix, p. 459). Two out of five of Hintze's cases of this condition showed cirrhosis of the liver.

In these states the iron-pigment is not

only present in the liver, but is abundant more especially in the non-striated muscle, more especially in the intestines, in the lymphatic glands, and it may be also in the pancreas, spleen, salivary glands, etc. Lubarsch (*ibid.*, p. 495) ascribes this condition either to secondary results of large hæmorrhages or to the development of multiple capillary hæmorrhages whereby the iron of the hæmoglobin is taken up and deposited in this modified form into the various organs. Possibly there is an intimate connection between the occurrence of multiple small hæmorrhages in the portal area and the production of this pigmented cirrhosis; rarely the skin also becomes pigmented and shows a bluish color.

[Bronzed diabetes. In association with diabetes there also occurs, rarely, a combination of pigmentation and bronzing of the skin, and cirrhosis of the liver of the "mixed" portal type. The cases of this *diabète bronzé* have been noted almost exclusively in France, though Saundby, in England, has recorded one case. In many cases of diabetes, more especially in the early stage, the liver is found enlarged; Saundby, indeed, concludes that it is generally enlarged, weighing from 50 to 60 ounces. The enlargement is, in the main, due to chronic congestion, but a small amount of interstitial hepatitis is frequently present, and occasionally this is so extensive as to produce distinct cirrhosis. In such cases the liver is sometimes smooth, at other times it is found granular and scarred. Brault and Gillard are of the opinion that the new growth begins in both the hepatic and portal areas, by which I infer that they would indicate that the process is of the mixed type. The accounts given in the French journals are, in general, so meagre, that it is difficult to arrive at any satisfactory conclusions as to the intimate nature of the pigmentation which has, at times, been found to accompany this cirrhosis. (For another

form of pigmental cirrhosis, the "cirrhosis arthracotica" of Welch, see later under SPORADIC CIRRHOSIS.) J. GEORGE ADAMI.]

Cirrhosis with pigmentation. Series of 49 cases of atrophic cirrhosis of the liver (Laennec's) treated in the wards of the Johns Hopkins Hospital. None showed permanent pigmentation. Eight cases of hypertrophic cirrhosis of the liver were also studied, and one of these presented bronzing of the skin. The clinical analysis made by Anschutz, who studied 24 cases collected from the literature up to 1899, shows that the symptoms are those of rapidly fatal diabetes mellitus accompanied with cirrhosis of the liver, commonly of the hypertrophic variety. The pigmented cirrhotic liver is found at autopsy. This pathological manifestation was found in 23 out of 24 of Anschutz's cases; in all but 1 instance the liver was enlarged. It contained an ochre-colored, iron-containing pigment. This pigment was present in the liver-cells and in the connective tissue. In 15 of the cases there was also a marked increase in the amount of the connective tissue of the pancreas, and 18 of the cases revealed pigmentation of the pancreatic epithelium and connective tissue. The pigment of the liver is now generally believed to be the exciting cause of the liver changes. Opie designated this pigmentation of the liver and pancreas as a distinct pathological entity, and the term hæmochromatosis should be used to designate this condition. The conclusions of Opie were as follows: "1. There exists a distinct morbid entity, hæmochromatosis, characterized by the wide-spread deposition of an iron-containing pigment in certain cells, and an associated formation of iron-free pigments in a variety of localities in which pigment is found in moderate amount under physiological conditions. 2. With the pigment accumulation there is a degeneration and death of the containing cells and the consequent interstitial inflammation, notably of the liver and pancreas, which become the seat of inflammatory changes, accompanied by hypertrophy of the organ. 3. When the chronic interstitial pan-

creatitis has reached a certain grade of intensity, diabetes ensues and is the terminal event in the disease."

Report of a personal case in a male 50 years of age. The skin, particularly that of the hands, wrist, and the legs, was deeply bronzed. The liver was markedly enlarged, and the urine did not contain albumin or sugar, but gave a reaction for indican and iron. T. B. Fletcher (*Jour. Amer. Med. Assoc.*, Sept. 28, 1901).

7. CIRRHOSIS WITH CALCIFICATION.—

I am acquainted with only one well-marked example of this condition, described by Taggart (*Trans. Path. Soc. London*, '89), in which the deposit of calcareous matter in the cirrhotic liver was so extensive that a saw had to be used in order to make sections of the organ.

Symptoms.—The condition of portal cirrhosis begins insidiously and may continue to an extreme condition without producing any symptoms which call attention to the existence of the process. Very frequently the earliest symptoms are associated with the alimentary tract; next in order are evidences of portal obstruction, and only when the condition is very well marked may there be disturbances referable to the hepatic function. Whether the gastric and intestinal disturbances are primary or secondary is a matter concerning which there has been debate. That they are not entirely due to the overfilling of the gastric and intestinal vessels in consequence of the portal obstruction is, I think, evident from the fact that they appear long before any signs of such obstruction show themselves, and if we ascribe alcoholic cirrhosis not so much to the alcohol itself as to the pathological condition of the stomach and intestines whereby toxic substances are absorbed from the food, then we must regard this as being the earliest disturbance in the course of the

disease. That at a later period the abdominal congestion further militates against the proper performance of the gastric and intestinal functions there can be no doubt. It would be well, therefore, to subdivide the symptoms into:—

1. The disturbances occurring in connection with the alimentary tract.
2. Symptoms of vascular obstruction.
3. Symptoms referable to disordered function of the liver and to altered metabolism.

SYMPTOMS REFERABLE TO GASTRIC AND INTESTINAL DISTURBANCE.—Of these the most noticeable are: at the very earliest stage slight dyspepsia, morning vomiting or nausea, and furred tongue; added to this there may be eructations and irregularity of the bowels. There is often an alternation of constipation and catarrhal diarrhoea. During the former of these the stools often present remarkable modifications: some days they are normal, then they become very dry and are covered with a thick layer of mucus; at other times they are colorless, and, as Graves has pointed out, in the same stool one may find portions which are gray, clayey, and others of normal color. To these disturbances of the digestive system may be largely attributed the emaciation of the later stages of the disease.

SYMPTOMS REFERABLE TO DISTURBANCES OF THE CIRCULATION.—So long as there is a well-established collateral circulation, for so long will there be no symptoms referable to obstruction. It is only when this collateral circulation becomes inadequate to carry the portal blood to the heart that ascites and other obstructive disturbances supervene. Thus, not infrequently we meet with extensive portal cirrhosis without a sign of ascites. Very frequently, however, the nature of this collateral circulation is the direct cause of death; more especially is

this the case with the plexus of submucous veins at the lower end of the œsophagus which plays a prominent part in this collateral circulation. These veins, being practically unsupported toward the free surface of the œsophagus, become varicosed and relatively enormous; the patient may appear in very fair health and the liver be performing its functions satisfactorily with but a thirty-second of an inch or less intervening between life and death; for it is these varicosed sub-œsophageal veins which are especially liable to rupture and to produce so extreme a hæmorrhage that death follows in the course of a few hours.

The best account of this collateral circulation is given by Osler and we here recapitulate it:—

“The compensatory circulation is usually readily demonstrated. It is carried out by the following set of vessels: 1. The accessory portal system of Sappey, of which important branches pass in the round and suspensory ligaments and unite with the epigastric and mammary systems. These vessels are numerous and small. Occasionally a large single vein, which may attain the size of the little finger, passes from the hilus of the liver in the round ligament and joins the epigastric veins at the navel. Although this has the position of the umbilical vein, it is usually, as Sappey showed, a para-umbilical vein; that is, an enlarged vein by the side of the obliterated umbilical vessel. There may be produced about the navel a large bunch of varices: the so-called *caput Medusæ*. Other branches of this system occur in the gastro-epiploic omentum, about the gall-bladder, and, most important of all, in the suspensory ligament. These latter form large branches, which anastomose freely with the diaphragmatic veins, and so unite with the vena azygos. 2. By the

anastomosis between the œsophageal and gastric veins. The veins at the lower end of the œsophagus may be enormously enlarged, producing varices which project on the mucous membrane. 3. The communications between the hæmorrhoidal and the inferior mesenteric veins. The freedom of communication in this direction is very variable, and in some instances the hæmorrhoidal veins are not much enlarged. 4. The veins of Retzius, which unite the radicles of the portal branches in the intestines and mesentery with the inferior vena cava and its branches. To this system belong the whole group of retroperitoneal veins, which are, in most instances, enormously enlarged, particularly about the kidneys, and which serve to carry off a considerable proportion of the blood.”

But in addition to the disturbance in the portal circulation, there appears to be also a frequent accompanying disturbance in the general circulation. It may here be more correct—inasmuch as this disturbance seems to be largely associated with alterations in the blood brought about by the hepatic disturbance—to refer to this under a later heading.

Case of alcoholic cirrhosis in which there were present enlargement of the liver, dilatation of the subcutaneous abdominal veins and ascites (necessitating four punctures in the course of a year). Small, erectile, venous tumors appeared on the face, in the pharynx, and on the internal surface of the last phalanx of the ring-finger of the left hand. The latter became the source of a quite-active hæmorrhage. Bouchard (Marseille-méd., Oct. 15, '91).

Ascites.—The ascites of portal cirrhosis develops gradually, and in this way is to be distinguished from that following thrombosis of the portal vein. While it is a very prominent and characteristic symptom of the condition, it must be remembered that it is far from being

constantly present. Indeed, I may go further and point out that much of the failure of clinicians to recognize portal cirrhosis is due to the erroneous belief that ascites almost constantly develops. *It does not by any means*; only in advanced atrophic cases is it the rule. The older writers speak of it as being present in about 80 per cent. of the cases; more recent careful observers give a lower proportion, thus: Rolleston and Fenton (Birmingham Med. Review, Oct., '96) find, from the post-mortem records at St. George's Hospital in London, that of 114 cases only 36, or a little over 30 per cent., showed ascites. Kelynaek in 121 examples (*ibid.*, Feb., '97) of common hepatic cirrhosis, as he terms it, coming to the post-mortem room at the Manchester Royal Infirmary, found ascites in 56 per cent.

With reference to these figures, it must be remembered that these are statistics, not of cases of portal cirrhosis recognized as portal cirrhosis during life, but in the post-mortem room, and this will explain the low percentage here given. Nevertheless they show very clearly that ascites is not the frequent and necessary accompaniment that is generally held. The fluid in these cases is clear, but may be slightly bile-stained; after repeated tapping it assumes more the character of an inflammatory exudate. According to some French observers, it begins as a subacute peritonitis; this is, however, doubtful. The fluid is alkaline, with a specific gravity varying between 1010 and 1015, though, if there has been any peritonitis, this specific gravity and the percentage of proteid are increased and the fluid may show spontaneous coagulation. Hale White, in his article on "Perihepatitis" (Allbutt's "System of Medicine"), holds that ascites proper is a late event in cirrhosis, for which more than

one tapping is rarely required, and regards those cases in which multiple tapplings are necessary as being complicated with peritonitis; indeed, he goes so far as to hold that, where ascites is directly due to cirrhosis and paracentesis is necessitated, the patient rarely lives long enough after the first tapping for the second to be necessary. Of 10 cases which were recorded during life as having cirrhosis, but were tapped oftener than once, of 4 at post-mortem examination, 3 were found to be cases of chronic peritonitis and perihepatitis and 1 of colloid disease of the peritoneum; the remaining 6 had more or less chronic peritonitis associated with the cirrhosis which was present. In fact, he would employ this as of diagnostic value as between uncomplicated cirrhosis and peritonitis or perihepatitis with or without cirrhosis.

Form of cirrhosis of the liver consequent upon the circulatory obstruction due to pericardial lesions. There is, at times, a clinical difficulty as to whether an hepatic enlargement with more or less ascites is a primary or secondary disease, especially where there are obvious physical signs of a valvular lesion and hardly any of back-pressure. Three cases of this form of pseudocirrhosis witnessed. Pick (*Zeit. f. klin. Med.*, B. 29, H. 5, 6, '96).

Œdema of the feet is not infrequently secondary to ascites, and is, in the main, due to a pressure of the distended abdominal contents upon the veins coming from the lower extremities. According to Osler, œdema of the feet may precede the development of the ascites, in which case it is to be ascribed to the malnutrition of the patient and the impoverished condition of the blood. The dropsy rarely becomes general.

Enlargement of the Spleen.—This is far more frequent than is ascites. Thierfelder found, out of 172 cases, only 39, or 22 to 23 per cent., in which this symp-

tom was absent; indeed, it may be regarded as the most common of the symptoms associated with portal cirrhosis. Oestreich is inclined to believe that this enlargement of the spleen is not entirely due to portal obstruction, in that it appears at so early a stage of the condition before other marked signs of such obstruction are evident; indeed, it is suggested that the toxic causes which are at work to produce the hepatic lesion bring about enlargement of the spleen.

If passive congestion be the cause of splenic enlargement, why is the spleen so frequently small and hard in cases of chronic passive congestion of the abdominal viscera due to heart disease? F. P. Weber (Edin. Med. Jour., N. S., vol. ii, p. 579, '97).

The average weight in the spleen in hepatic cirrhosis is 12.93 ounces, while in cardiac cases it averages only 7.32 ounces. Again, the greatest enlargement of the spleen is not found where the portal obstruction is greatest, but in those cases of portal cirrhosis where ascites is delayed till the last or is wholly absent. Kelynack (Edin. Med. Jour., N. S., vol. ii, p. 579, '97).

Weber, like Oestreich, is of the opinion that toxæmia is the cause of the enlargement. The organ is enlarged from one-half to three times its normal size; in one case of portal cirrhosis which recently came under my notice, it weighed 720 grammes. Describing a similar case of large splenic tumor, Banti compares it with the malarial spleen, and urges the probable infectious origin of such cases.

Case of splenomegaly followed by hepatic cirrhosis in a middle-aged woman. There was no history of malaria or syphilis, but she had suffered for many years from pellagra. There had been no abuse of alcohol. Bonardi (Gazz. degli Osped., Jan. 3, '97).

Case of hypertrophic cirrhosis of the liver in a boy 9 years old. At the autopsy the liver was found to weigh 650 grammes, had a yellowish-green color and an irregular surface; a large num-

ber of fibrous bands traversed the organ, the bile-ducts were dilated, the spleen hard. Dellemagne and Tordens (Jour. de Clin. et de Thérap. Inf., vol. v, No. 17, '97).

Hæmorrhoids.—While hæmorrhoids are frequent in cases of portal cirrhosis, the majority of recent writers are of the opinion that they are far from being as common as used to be taught.

Pain and Tenderness over the Region of the Liver.—This latter is often most noticeable in the early stages, and is often accompanied by a sense of epigastric fullness and tension, which may be present through the duration of the disease. As Ross pointed out and explained in his remarkable article in the tenth volume of Brain, besides these sensations referred directly to the diseased organ (or conditions of *splanchnic* pain), there may be other painful sensations which may be termed *somatic*, or referred pains. The liver is innervated from the seventh to the tenth dorsal, and, as a consequence, the pain affecting the organ may be referred to the cutaneous branches of these nerves by overflow of irritation in the cord, and, as a matter of fact, pain is frequently felt in the region of the angle of the right scapula. Another pain at times experienced is that at the tip of the right shoulder, more rarely of both shoulders. Where this is the case there is an indication of involvement of the upper surface of the organ, extending to the diaphragm, for such pain is brought about by the overflow of irritation at the point of entry of the phrenic nerve into the spinal cord; and so there is reference to pain along the branches of the lower cervical nerves, the phrenic arising chiefly from the fourth cervical with a few filaments from the third.

SYMPTOMS REFERABLE TO DISTURBED FUNCTION.—*Jaundice.*—One of the most constant symptoms of portal cirrhosis is a

slight icteroid tinge of the conjunctivæ accompanied by a bright, watery appearance of the eyes. The skin, in general, save where there is frank development of ascites, is pale rather than icteroid, but as the disease progresses the face gains a sallow, ashy tinge. In the very rare extreme cases of pigmentary cirrhosis the skin may assume a slaty-blue or in some cases, as in diabetic cirrhosis, a bronzed appearance similar to that seen in Addison's disease.

Jaundice, however, may show itself in any period of the disease; it is characterized by not presenting that continuous and progressive severity observable in cases of true biliary cirrhosis. According to Fagge, at Guy's Hospital, out of 130 cases, only 35 showed this symptom, or just under 27 per cent., and, according to Price (quoted by Graham), the proportion is lower, namely: 17.5 per cent.

Urine.—In the earlier stages there may be little or no change, but, as the condition progresses, the quantity diminishes in amount, the color becomes dark, and, as Hayem and von Jaksch have pointed out, the greatly-increased amount of urobilin is an indication of considerable value where the diagnosis is doubtful. Save where there is a frank condition of jaundice, bile-pigments are absent. The urea is often found diminished; the urates, on the other hand, markedly increased. Albumin is, at times, present, with casts, apart from those casts which may be associated with jaundice. Kely-nack found renal cirrhosis present in a little over 18 1/2 per cent. of his cases.

The carbohydrates in cases of cirrhosis of the liver are not excreted as sugars by the kidneys, although they are found as such in the serous exudates in the pleural and abdominal cavities. Colasanti (*Riforma Medica*, Mar. 27, '91).

Study of the urine in cirrhosis of the liver; conclusions: 1. The quantity of

urea eliminated in twenty-four hours is much diminished, but presents variations from day to day. 2. Milk diet augments the elimination of uræa and favors diuresis. 3. With the diminution of the elimination of urea, that of ammonia increases; with a milk diet this is reversed. 4. The chlorides keep pace with the urea. 5. Oxidized urochrome and urobilin are diminished during a milk regimen. Ajello and Solaro (*Il Morgagni*, Feb., '93).

Case of a patient in whom cirrhosis of the liver was combined with diabetes mellitus. He was under observation for nearly eight and a half years. The first symptom to appear was slight jaundice, followed some months afterward by certain diabetic symptoms, namely: thirst, and sugar in the urine, to the amount of 1 1/2 to 2 per cent. This yielded to appropriate treatment, but five years afterward ascites appeared, along with slight jaundice, enlargement of the liver and spleen, and some dropsy of the feet, etc. At the necropsy, marked cirrhosis of the liver, with enlargement of the spleen and kidneys, as well as tubercular deposits (both old and recent), were found. Hepatic cirrhosis in such cases is of a special kind and holds an intermediate position; it is characterized by marked increase in the size of the liver and spleen, with but little tendency to contraction on the part of the former, and also by the presence of pigmentation in the skin. Pusinelli (*Berl. klin. Woch.*, No. 33, '96).

The Blood.—There is very little that is characteristic about the condition of the blood in portal cirrhosis. There is no marked increase in leucocytes, no extensive diminution either of the hæmoglobin or of the number of red blood-corpuscles, but the tendency toward epistaxis and the development of petechiæ in connection with the general, as opposed to the portal, circulation would seem to indicate that either the blood is of such a poor quality or contains such abnormal and toxic substances as to lead to degeneration of the capillary walls,

and, as already pointed out, the occasional occurrence of œdema preceding ascites is another indication of this toxic or impoverished condition of this fluid. While the hospital is of such relatively-recent establishment, and the number of cases of portal cirrhosis in post-mortem records too few to establish definite statement, I have been struck by the frequency with which, during life, the clinical records at the Royal Victoria Hospital, Montreal, note an apical systolic murmur, recognized as functional, the post-mortem confirming its functional nature.

A further indication of the altered or thinned condition of the blood is the not-infrequent existence of a venous hum in the epigastric region noted by several recent observers and of a splenic soufflé first noted by Bouchard.

Other Symptoms Referable to Disturbed Hepatic Function.—Very characteristic toward the latter stage are certain nervous symptoms, which also are, in general, attributed to a toxic condition of the blood. These are, by some, classed as manifestations of cholœmia, although, as they may be present when there is no evidence of the passage of bile into the blood, this use of the term is scarcely exact. I refer to the drowsiness of many patients and the more marked nervous conditions of coma and delirium. Where death is not due to hæmorrhage or intercurrent disease, such as tuberculosis, it is these nervous disturbances which are the prominent feature in the fatal event. These nervous symptoms may be mistaken for the onset of urœmia. There may be marked excitation, or, on the other hand, a progressive and deepening stupor passing into complete coma.

Case of hæmorrhage from the larynx in the course of alcoholic cirrhosis. Hæmatemesis and epistaxis also occurred. Laryngeal hæmorrhage ascribed to the

interference with the hæmatopoietic functions of the liver by the atrophic cirrhosis of that organ. Lubet Barbou (*Archives de Laryn.*, July, Aug., '97).

Study of sixty cases of fatal gastro-intestinal hæmorrhage due to cirrhosis of the liver. 1. Fatal gastro-intestinal hæmorrhage is an infrequent, but not rare, complication of cirrhosis of the liver. 2. In the great majority of the cases the cirrhosis is atrophic, but it may be hypertrophic. 3. In one-third of the cases the first hæmorrhage is fatal; in the other two-thirds the hæmorrhages continue at intervals over a period varying from a few months to several years, the maximum given being 11 years. 4. In one-third of the cases the diagnosis can be made at or before the time of the first hæmorrhage. In the other cases the diagnosis cannot be made at all or only after months or years, during which time other symptoms of cirrhosis may have developed. 5. Œsophageal varices are present in 80 per cent. of the cases, and in more than half of this 80 per cent. the varices show macroscopical ruptures, and it is probable many other ruptures would be found if the varices were tested by injections of air or fluid. 6. Fatal hæmorrhages occur in cases which show no œsophageal varices, and they are probably due to the simultaneous rupture of many capillaries of the gastro-intestinal mucous membrane. 7. The hæmorrhages in this class of cases are usually preceded by other symptoms of cirrhosis, but the first symptom may be a fatal hæmorrhage. 8. In 6 per cent. only of the cases which showed œsophageal varices was the cirrhosis typical: *i.e.*, showed ascites, enlarged spleen, and subcutaneous abdominal varices. R. B. Preble (*Amer. Jour. Med. Sci.*, Mar., 1900).

Differential Diagnosis.—The preceding pages will have given in fairly full detail the main features characterizing the different forms of hepatic cirrhosis. Here, however, it may be worth while to point out again that there are four forms of hepatic cirrhosis, or of conditions clinically regarded as cirrhosis, between which we have to distinguish, namely:

portal cirrhosis proper, biliary cirrhosis, chronic perihepatitis, and gummatous syphilis of the liver. All other forms, with the exception of the pericellular syphilitic cirrhosis of the infant, are clinically unrecognizable.

Leaving aside, for the moment, the most important of these,—namely, portal cirrhosis,—the main features whereby the biliary form of the disease is to be differentiated are the progressive icterus, the enlargement of the organ, the absence of marked digestive disturbances, the long continuance of the condition, and the retention of appetite and strength. The coloration of the stools by bile and the more extensive enlargement of the organ must be the main factors in diagnosing between what we may term the catarrhal form of biliary cirrhosis and the very rare purely-obstructive form.

GUMMATOUS SYPHILIS is only likely to be confounded with portal cirrhosis when, through obstruction to the portal circulation, ascites supervenes. Under these conditions the organ may be either of normal size or greatly contracted by a multitude of syphilitic cicatrices. In the former case the coarse lobulation of the organ is more likely to lead to the diagnosis of cancer of the organ than of portal cirrhosis; in the latter case the signs and symptoms may be so closely allied to those of portal cirrhosis as to render diagnosis a matter of extreme difficulty. The presence of syphilitic lesions elsewhere, and the history of the case, may help toward the diagnosis, which will be finally determined by the effects of antisyphilitic treatment.

GENERALIZED FIBROID PERIHEPATITIS may, with great difficulty, be distinguishable from true portal cirrhosis. If the organ can be felt, the rounded character of the edge, the absence of roughness of

fine nodulation on palpation, the presence of a thickened omental mass below the liver, all are in favor of a diagnosis of perihepatitis. As already stated, according to Hale White, if a patient is able to stand a long series of tappings of the ascitic fluid, the diagnosis is against the existence of an uncomplicated portal cirrhosis, and is in favor either of chronic peritonitis associated with perihepatitis or of portal cirrhosis complicated by chronic peritonitis.

The main points elicited in the preceding pages with regard to portal cirrhosis and its diagnosis are the following:—

1. That the small size of the organ is by no means the main diagnostic feature of this condition. Only in advanced cases, and by no means always then, is the organ markedly atrophied. Of far greater diagnostic importance is the determination of progressive diminution in size of the organ.

2. If the organ be palpable, the recognition of a finely-nodular, firm surface indicates with relative certainty the existence of this condition.

3. Contrary to general opinion, in only about 50 per cent. of the cases in which the autopsy reveals a well-developed condition of portal cirrhosis is there ascites.

4. Enlargement of the spleen is a much commoner symptom, and this is present in more than 80 per cent. of the cases.

5. Jaundice is present in about 30 per cent. of cases. Such jaundice tends to be transient and to develop after other symptoms have been present some little time.

6. From the very onset of the condition gastric and intestinal disturbances form a prominent feature in the disease.

7. The progressive emaciation and weakness are also characteristic, and with

this may be associated a peculiar, sallow, slightly-earthly complexion.

8. A urine free from sediment (mainly of urates) is against the diagnosis of cirrhosis; while the presence of increased quantities of urobilin is, in the presence of other symptoms, in favor of such a diagnosis.

Of other conditions affecting the liver which may be confounded with cirrhosis are to be mentioned cancer, thrombosis of the portal vein, senile or marantic atrophy of the liver, and cyanotic induration.

Of these, PORTAL THROMBOSIS may occur as a complication of cirrhosis. Where this occurs in the absence of cirrhosis the main distinguishing feature is the rapid development of the ascites and its rapid return after tapping. At the same time, such thrombosis is secondary to disease of other abdominal organs, more frequently of the intestinal tract, and the symptoms proper to such disease will have preceded the development of ascites.

CANCER OF THE LIVER is characterized by the increase in size of the organ, the presence of large nodules presenting umbilication, the absence of splenic enlargement, the cancerous facies, and, in general, the presence of cancerous nodules elsewhere. Those cases in which cancer of the organ is present without the development of nodules upon the anterior surface of either lobe at times cause very great difficulty. Here the small size of the spleen, the character of the urine, the complexion, and other signs and symptoms, which ordinarily are regarded as of secondary importance, become of the highest value in diagnosis.

Attention called to the occasional resemblance between hypertrophic cirrhosis and hepatic carcinoma, and stress laid upon the difference in the stools, which are bilious in the former, clay-colored in

the latter. Freyhan (*Deutsche med. Zeit.*, May 8, '93).

In cases of SENILE, or MARANTIC, ATROPHY the organ, if it can be palpated, is smooth; there is absence of ascites and of jaundice.

The ATROPHIC NUTMEG LIVER (cyanotic induration) and also the "hypertrophied" nutmeg liver are also characterized by the smooth surface of the organ, as also by the prominent symptoms of obstructive disease of the heart.

Other forms of ascites and peritonitis are not infrequently mistaken for the results of cirrhosis; indeed, I think it may be said with confidence that the most frequent cause of false diagnosis of cirrhosis, is either CANCEROUS or TUBERCULAR PERITONITIS. In such cases there may be present gastric and intestinal disturbances easily mistaken for those accompanying cirrhosis; the ascites may be of gradual development, as in portal cirrhosis; and the liver, being, by the accumulation of fluid, forced upward, may disappear behind the ribs and so be diagnosed as presenting great atrophy. Between cancerous and tubercular peritonitis the distinction may be drawn that in the former the spleen is not enlarged, and in the latter the enlargement may be as extensive as in portal cirrhosis. In these cases, again, it is the secondary symptoms and signs which are of the greatest value in arriving at a decision: complexion, urine, etc., and, in addition to these, the character of the abdominal fluid when removed. Most important, also are manifestations of disease elsewhere, either cancerous or tubercular. In cases of doubt, to determine the tuberculous nature of the condition, it is well to inoculate a rabbit or guinea-pig, and, for the recognition of cancer, to make a careful search for cancer-cells in the removed fluid.

Complications.—Leaving out of account the rare cases of development of a primary adenomatous or cancerous condition, there may be other complicating conditions in the liver itself of the nature of degenerative changes; in advanced cases it is not infrequent to meet with evidence of fatty degeneration of the cells as distinct from the fatty infiltration seen in less advanced conditions; more rarely is amyloid degeneration present. Thrombosis of the portal vein occurs occasionally.

TUBERCULOSIS.—The most frequent complication outside the liver is the development of tuberculosis. Rolleston and Fenton find pulmonary tuberculosis in 32 out of 114 cases, tuberculosis being the direct cause of death in 17. Kely-nack, out of 121 cases, finds tuberculosis either active, latent, or obsolete in 28: *i.e.*, 23 per cent. Of these 28, in 14 the condition was active in the lungs, in 12 in the peritoneum, and in 7 both in the lungs and peritoneum. Twelve, or about 10 per cent., of the cases died directly from tuberculosis; in 8 per cent. the condition was latent or obsolete.

Tuberculosis is a cause of cirrhosis of the liver. The liver becomes generally atrophied, indurated, and granular, like the cirrhosis which results from the abuse of alcohol, although in a less degree. More rarely, it becomes deeply furrowed and lobulated, as in syphilitic cirrhosis. Hanot and Gilbert (*La Sem. Méd.*, Feb. 3, '92).

A case of infectious cirrhosis of the liver, of unknown origin, in a rabbit that had been inoculated with a fragment of epithelioma of the kidney. Tuberculosis was not found in other organs, and tubercle bacilli could not be found in the hepatic lesions. Psorosperms were likewise absent. The histological appearances were unique, and indicated that the infection had spread from the centre to the periphery. Pilliet (*Bull. de la Soc. Anat.*, No. 17, '93).

Other frequent complications are: **RIGHT-SIDED PLEURISY** with a serous or sero-sanguineous exudation. This condition has not, as yet, been thoroughly worked out; so far as I can see it is not of a tuberculous nature, for I have come across cases showing such pleurisy in which there has not been a sign of tuberculosis at the post-mortem. Where it is present I have also noted a co-existence of adhesions between the upper surface of the liver and the diaphragm, which might indicate an extension of the inflammatory process from the liver to the pleural cavity. Were this so, it would be evidence in favor of microbic origin or microbic complication in the hepatic condition; but, as already stated, this subject requires much further study; occasionally there is evidence of bilateral pleurisy.

Pleuritic effusion on the right side only, in Laennec's, generally considered as an exceptional symptom is, however, a constant symptom. Found in nine cases of cirrhosis. It is of value in the diagnosis of doubtful cases, when it is difficult to determine whether ascites is due to cirrhosis of the liver, to thrombosis of the portal vein, or to compression of that vessel by tumors or swelled glands. G. Villani (*Riforma Medica*, Mar. 9, '95).

Another frequent complication is **NEPHRITIS**, either of the granular type or not infrequently as a mixed interstitial nephritis, of what Formad has termed the "hog-backed" type, the organ being enlarged, more especially from before backward, and showing microscopically a condition of mixed interstitial and parenchymatous nephritis. The interstitial type is, in general, associated with evidences of some degree of general arteriosclerosis and with other complications due to this process. Both the interstitial and the hog-backed kidney are, it need scarcely be said, characteristic of

alcoholism. The statistics of the various authorities with regard to the frequency of renal complications are not sufficiently extensive to arrive at any very satisfactory conclusion. G. Foerster, in his 31 cases recorded at Berlin, found nephritis 3 times, granular atrophy 4 times, and "indurated" kidney 4 times. Kelyack found renal cirrhosis in a little over 18½ per cent. of his cases. Gärtner found 11 out of 12 to show "chronic nephritis"; 10 of these were habitual drinkers of brandy.

Other alcoholic complications may also be present, notably some extent of chronic pachymeningitis and thickening of the dura mater, and fatty degeneration of the heart-muscle.

Lastly there is a liability for acute inflammatory processes to supervene: pneumonia, acute bronchitis and pericarditis, erysipelas of the cedematous skin, and acute peritonitis; this last often secondary to paracentesis.

Prognosis.—The condition begins so insidiously that it is difficult to make an accurate statement concerning its duration. It will be generally agreed that Fitz is not too hopeful in stating that the fatal result may be expected within a year after hæmorrhage or other sign of portal obstruction. Von Kahlden instances a case (*Münch. med. Woch.*, 48, '97) of a very acute development of the disease in which death occurred three and a half months after the first symptoms presented themselves. The form of cirrhosis in this was of a mixed type. If the cases of Carrington and Cayley are to be regarded also as examples of portal cirrhosis, we have further evidence that the disease may be fatal in three months after the first occurrence of dyspepsia and of epigastric fullness, or two months after the first onset of ascites. At the other extreme, we come across many

cases, in the post-mortem room, of well-developed portal cirrhosis which had given rise to no symptoms during life. Thus, clearly the condition may be present in a latent or it may be in an arrested form for months and it may be for years. It is difficult to explain otherwise a case such as that of Taggart's, in which the cirrhotic tissue had undergone calcification. It is difficult, also, to know how to regard those cases in which, cirrhosis being diagnosed, after one or two tapings the symptoms disappear and the patients apparently recover, because these cases may have been conditions, not of true cirrhosis, but of subacute perihepatitis. If, by palpation and by other physical signs and symptoms, and more especially by the character of the urine, it is determined that portal cirrhosis is present, prognosis is very bad.

Both Rolleston and Kelyack agree that a little under half the cases die directly from the effects of hepatic cirrhosis, though it is a little doubtful what effects they include under this term.

Treatment.—There is no treatment known save the palliative, and it is, indeed, difficult to see how to arrest the condition once there is marked development of this contracting, fibrous tissue in the organ. The avoidance of alcohol, spices, coffee, and other irritant substances; avoidance of fatigue and of cold, together with maintenance of regular action of the bowels by mild aperients are all indicated. Several authorities have recommended a milk diet, but, according to Jaccoud and others, it has absolutely no effect in arresting the progress of the disease.

In cirrhosis of the liver abstention from alcohol and all stimulating ingesta is the first requisite. Diet should be restricted to milk, eggs, simple proteids, bread, and fresh fruit and vegetables. Predigested foods are necessary in some

instances. W. B. Cheadle (*Lancet*, Apr. 14, 1900).

Some more recent writers recommend massage as improving the general condition of the patient. The treatment which affords most relief would appear to be the employment of alkaline mineral waters and saline purgatives, whereby some relief is given to the congestion of the portal system.

Where ascites is present, tapping gives great relief, and, as pointed out by Murchison and recommended by Graham in his admirable article in the Loomis-Thompson "System of Practical Medicine," after this tapping digitalis and diuretics are both effectual and useful.

Special attention drawn to the value of urea as a diuretic. Two and a half drachms given in the day, increased up to 5 drachms, continued for 2 or 3 weeks. No unfavorable effects witnessed. The unpleasant taste may be done away with by drinking milk immediately after taking it. G. Klemperer (*Berl. klin. Woch.*, Jan. 6, '96).

Report of a case which improved remarkably under the administration of apocynum Cannabinum (Canadian hemp), 5 drops of the fluid extract thrice daily. Whenever the patient interrupts it for a few days ascites reappears. F. J. Bowles (*Therap. Gaz.*, Feb., 1901).

The treatment should be largely dietetic and hygienic, great care being taken to see that the functions of the gastro-intestinal tract are kept in action and the renal secretions properly regulated as well as the action of the skin. Three deaths personally known to have followed the operative treatment of hæmorrhoids, and at the necropsy cirrhosis of the liver was discovered for the first time. In all cases of hæmorrhoidal disease a thorough knowledge of the state of the liver should be obtained before any operative interference is advised. In the treatment of ascites mild purgation and calomel from time to time; calomel also

used in $\frac{1}{40}$ -grain dose every three hours as a diuretic. The old-fashioned pill, digitalis, squills, and calomel and copaiiba are useful. Tapping is resorted to early and frequently. J. H. Musser (*Phila. Med. Jour.*, June 15, 1901).

After hæmorrhage from the œsophagus of the stomach, ice should be taken internally and morphine may be given.

The operation of bleeding has so fallen into disuse that scarce any authority recommends this as a means of rapidly relieving the congestion. Personally I have been struck at autopsies by the amount of blood still present in the organs even when profuse hæmorrhage has been the cause of death; and it seems worth while to suggest that, where other means fail, the removal of blood from the general circulation, by temporarily lowering the general blood-pressure, is capable of aiding the more rapid flow of blood from the congested portal circulation into the inferior vena cava and vena azygos, and so is capable of aiding the development of a more satisfactory collateral circulation.

SURGICAL TREATMENT OF ABDOMINAL DROPSY FOLLOWING CIRRHOSIS OF THE LIVER.—The operation devised by Talma consists of an abdominal section, preferably between the umbilicus and ensiform cartilage, evacuation of the accumulated fluid, and scraping of the parietal peritoneum with a curette or rubbing off the epithelium with a gauze sponge. The superior surfaces of the liver and of the peritoneum covering the diaphragm are also rubbed. The omentum for three or four inches around the incision is then stitched to the parietal wall, and is included in the sutures which close the abdominal incision. A broad surface is available for adhesions, and it is the additional collateral circu-

lation thus obtained which constitutes the main feature of the operation. Its formation, however, is comparatively slow, and it is frequently necessary to tap the patients several times after the operation, before the collateral circulation is complete.

Since the first operation for cirrhosis of the liver, 13 have been performed. Of these, 5 have recovered, 2 were improved, in 1 there was no change, and 5 died. Operation is indicated in cases in which there is a distinct mechanical hindrance in the portal circulation with recurring ascites. The technique consists of a small incision into the abdominal cavity, through which a careful exploration is made of the liver, gall-bladder, and the surrounding parts. The peritoneum is curetted over the anterior surface of the abdomen, and the great omentum is attached by sutures to the abdominal wall. The peritoneum has its epithelial covering removed over the lateral and anterior portion on the left side of the abdomen, to which the spleen is likewise attached. A glass drain is then inserted, and all ascitic fluid of the abdominal cavity is removed. This drainage is continued until no further fluid is formed, which shows that the collateral circulation has been established. F. Friedmann (*Centralb. f. d. Grenzgebiete der Med. u. Chir.*, Aug. 8, 1900).

The operation for creating compensatory circulation in hepatic cirrhosis is indicated in those cases in which the collateral circulation is not sufficiently established to relieve the rapidly increasing ascites. Although the cases operated on by Talma himself proved fatal, it was successful in 65 per cent. of cases operated by other surgeons. Two personal cases reported in which Talma's operation was performed. Two months later ascites again developed, six litres of fluid having been removed by tapping. After that the patient felt much stronger. The second case presented a history of chronic alcoholism, and was far advanced in the disease when Talma's operation was performed.

He improved after it for about two weeks, when he commenced to decline rapidly, and died within forty-eight hours. It is a simple and harmless method of treating ascites. N. M. Benisovitch (*Vratch*, Feb. 17, 1901).

All well-attested cases of cirrhosis presenting ascites should be operated upon under local anæsthesia. Frazier's table of fifteen cases reproduced, personal case being the fifteenth in the table. Frazier's list shows that 75 per cent. of recoveries had taken place. J. J. Jelks (*Med. Record*, Mar. 23, 1901).

Case of hepatic cirrhosis in which Talma's operation was performed about a year ago. The liver and spleen were in the same condition; the circulation had improved; collateral circulation was well established; and the ascites did not recur. Scherwineky (*Med. Obosrenije*, Mar., 1901).

Two cases of cirrhosis of the liver in which Talma's operation was performed. The operation may be of benefit in two ways: First, by diminishing the congestion of the liver; second, by increasing the vascular supply of the surface cells so that they may undergo compensatory hyperplasia. The ascites is due almost exclusively to the portal obstruction. Drainage may be made through the larger opening. The abdomen should be encircled with broad adhesive strips. Twenty-two cases have been recorded, giving the following results: Immediate death, 5; ultimate death, 3; unimproved, 3; improved, 2; recovered, 9. The operation strongly recommended. F. Packard and le Conte (*Amer. Jour. Med. Sci.*, Mar., 1901).

Statistics show that six cases at least have been cured of ascites by stitching the omentum to the anterior abdominal wall, and which remained well for a period of two years or more. Six others were relieved of this symptom for from two to six months, but died, either without a return of the ascites or have been under observation long enough to demonstrate that the cure is permanent. A case of hæmorrhage from the alimentary canal was promptly cured by the above operation. Thirty-eight cases recovered from the operation, and, when we con-

sider that in the majority of instances these patients were in the last stages of an incurable disease and would have died within a few weeks, it seems that if these cases were taken earlier there would have been more encouraging results. G. E. Brewer (*Medical News*, Feb. 8, 1902).

Biliary Cirrhosis.

Under the term "biliary cirrhosis" two distinct conditions are to be included:—

1. A condition rare, clinically, but produced experimentally in the lower animals by Charcot and Gombault by ligation of the common bile-duct. A condition in which obstruction of the larger bile-ducts is followed by inflammatory condition of the intrahepatic and extrahepatic bile-ducts, and the later development of fibrous tissue around them.

2. A condition in which the liver is found permanently enlarged, with the development of much rather loose and non-contracting fibrous tissue, in which, as evidenced by the accompanying jaundice, there is some hindrance to the free flow of bile through the smaller ducts, for no obstruction of the extrahepatic bile-ducts is to be recognized.

A further characteristic of this form is the peculiar extensive development of the already-described new bile-ducts in the hyperplastic fibrous tissue.

1. OBSTRUCTIVE CIRRHOSIS.

Definition.—The cirrhosis of obstruction of the large bile-ducts.

It may be laid down as a rule that the simple obstruction of excretory passages leads, not to fibrosis, but to distension and atrophy of the cells and tissues bordering upon the ducts, and, as a matter of fact, the majority of cases of long-continued biliary obstruction from gall-stones or from pressure upon the common bile-duct is accompanied by no obvious increased development of fibrous tissue in the organ. Certain rare cases,

however, do occur where there is a very characteristic increase in the connective tissue around the bile-ducts in the liver. Why this should be so it is difficult to explain, unless there be some cause over and above the simple obstruction. What this cause is is impossible to say, because in some of the best-marked early cases—as, for example, one of Kanthack and Rolleston and another of Heneage Gibbes—the condition shows itself in children which have died at such an early age that the condition must be regarded as congenital. Possibly some constituent of the excreted bile acts in these cases as an irritant.

[Well-marked cases of this type of cirrhosis in the adult are distinctly rare. That of Kelch (*Revue de Méd.*, p. 969, '81) would seem to be the first surely of this nature. Goluboff's case (*Zeit. f. klin. Med.*, vol. xxiv, '94), while referred to a chronic and intermittent gall-stone obstruction, dating back for 11 years, was anatomically found to be of the type to be immediately dealt with. It is only to be expected that the one form should pass into the others. One of the best descriptions of the condition is given by Giggs (*Trans. Path. Soc.*, London, vol. xxxiv, p. 129, '83). A male infant began to show slight-yellowish tingeing of the skin and jaundice a few days after birth. The jaundice persisted, but was never very deep in color. Nutrition was maintained until the sixth month, when wasting and ascites supervened, the child dying during the next month. The liver in this case was hard and smooth; there was no trace of the common duct; the hepatic duct close to this organ was filled by a fibrous mass; the portal vein was normal. With these appearances it is difficult to comprehend why the jaundice was not of the severest type. Microscopically there was enormous increase of interlobular connective tissue growing around the bile-ducts and extending toward the junction of these with the liver-cells. I have been indebted to Dr. Rolleston for material from this case,

also one of congenital obstruction, and in this, coupled with evident dilatation of the intralobular bile-capillaries, there was an exquisite development of fibrous tissue, which was confined to the immediate neighborhood of the bile-ducts. J. GEORGE ADAMI.]

In all such cases the organ is enlarged, smooth, and fibrous, and progressive jaundice is the leading feature.

2. BILIARY CIRRHOSIS PROPER.

Synonyms.—Hypertrophic biliary cirrhosis; Hanot's cirrhosis.

So long ago as 1857 Todd drew attention to the fact that two different forms of chronic hepatitis are to be recognized, and quoted cases of enlarged cirrhotic liver without ascites, but with jaundice. Thus, if the name of any person is to be associated with this form of disease, it would be that of Todd, and not of Hanot, who, while he was the first to give a full study of this form, was certainly not the first to clearly draw attention to its existence. In 1859 Charcot and Luys called attention to the fact that, in some cases of cirrhosis with enlarged liver, the new fibrous tissue penetrates into the lobules and becomes intralobular. In 1874 Hayem reported two cases of cirrhosis with enlargement, and in the same year Cornil pointed out the presence of great numbers of new bile-ducts in cases of cirrhosis of this nature; only in the following year, in 1875, did Hanot's well-known thesis appear upon the "Enlarged Cirrhotic Liver," in which he pointed out that in this form the enlargement is constant throughout, the surface smooth, and, microscopically, the cirrhosis is of the unilobular type and sometimes pericellular, with a plexus of small, new bile-canalculi; while, clinically, he showed that this form was characterized by permanent jaundice without ascites, death being due to the jaundice. He described the condition as

often due to a catarrhal condition of the smaller intrahepatic bile-ducts. The condition is a rare one, though each year two or three are reported in the journals. While in the majority of cases there is a definite history of hard drinking, the more recent observations of Hanot lead to the belief that the disease is of a possible infectious or microbic origin.

The liver in these cases may be enlarged symmetrically and may weigh as much as eight pounds.

Observation on the form of hypertrophic cirrhosis with chronic jaundice described by Hanot. 1. The splenic enlargement persists unaltered during the whole course of the illness, although the variations in the size of the liver may be considerable and of frequent occurrence. 2. The splenic enlargement precedes the alterations in the liver, or, at least, it precedes the outward manifestations of the disease. In one of the cases, a man who died at about 30 of this form of cirrhosis, a large spleen had been noted during youth. 3. The disease may sometimes occur in different members of the same family. Children of patients may have a large spleen without any other sign of the affection. In one family the children are said to have a very pigmented skin, and this has been observed likewise in some collateral branches of the family. 4. The large spleen may be considered as the essential part of the disease. 5. Although ordinarily malaria has nothing to do with the affection, the cause is probably analogous to that of malaria and dependent on drinking-water. 6. As Hanot and Riener admitted, the affection seems to be a specific one, or, at least, a peculiar infection of the spleen and liver, not a simple infection of the liver. E. Boix (*Presse Méd.*, Mar. 16, '98; *Brit. Med. Jour.*, May 14, '98).

Etiology.—In the first place, there is a marked distinction between this and ordinary portal cirrhosis, in that it affects young adults. By far the greater number of cases are in males between

the ages of 20 and 35. Schochman, in the 26 cases which he collected, found that it affected 22 males and 4 females. In the majority of cases there is a definite history of hard drinking; but, as in other cases there has been no alcoholic history, we must conclude that alcohol is not the immediate cause. So, also, malaria is to be eliminated. On the other hand, there is increasing evidence at the present time—not, it is true, absolutely convincing—in favor of regarding this form as definitely of infectious origin. In favor of this view are the following facts:—

1. The febrile character of the disease. As Jaccoud was the first to point out, the fever may reach from 103° to $103\frac{1}{2}^{\circ}$ F.

2. The very frequent extension of the inflammation, development of perihepatitis, and surrounding adhesions.

3. The condition of the blood. As Hanot and Meunier have shown (Soc. de Biol. de Paris, Jan. 25, '95), the number of white corpuscles in the blood of five cases was increased from 13,000 to 20,000 per cubic millimetre. No such leucocytosis is observable in ordinary portal cirrhosis.

Hanot, in his recent communications, is strongly in favor of the infectious origin. On the other hand, no definite micro-organism has been discovered, save that the presence of the colon bacillus has been recognized in the ducts upon more than one occasion. The frequency with which this form may be present in the gall-bladder and larger bile-ducts and there set up mild chronic disturbances is, nowadays, being more and more recognized.

But were the bacillus coli the causative agent, we should expect to find the disease far more common and far more frequently associated with cholelithiasis.

This fatal form of cirrhosis is peculiar to the Brahmin children. Brahmin women in childbed adopt a diet which may conduce to the disease in the newborn infant, in whom it has been seen. They restrict themselves to the use of a strong decoction of black pepper to allay thirst, abstaining from liquid of any other kind, and as food use balls made up of boiled rice, *ghee*, and coarse sugar. E. Mackenzie (Laneet, Feb. 2, '95).

Closely allied to this above variety of cirrhosis is the "pericellular cirrhosis" (*vide infra*): a form definitely associated with infection. Hence, on the whole, from all these considerations I am inclined to regard this provisionally as being a cirrhosis of infectious origin.

Pathology.—The liver is symmetrically enlarged and may weigh as much as eight pounds; it is, in general, smooth, herein being distinguished from portal cirrhosis; more frequently in that disease there are evidences of perihepatitis and of adhesions to the diaphragm and surrounding viscera. This perihepatitis at times gives a very hard surface to the organ. In the latter stages of the disease, where the condition has been of long continuance as Goluboff more recently has pointed out (Zeit. f. klin. Med., vol. xxiv, '94), there may be a certain amount of contraction of the enlarged organ, and the surface may take on a slightly-granular appearance. On section, the organ cuts very firmly, and has an intensely-jaundiced, dark-green appearance; the gall-bladder is full of bile of good color, clearly indicating that there is no absolute obstruction to the flow of bile from the organ, while the extrahepatic bile-ducts are free from obstruction.

Microscopically, the appearance is characteristic. Frequently, though not always, there can be made out around the larger bile-ducts, which are very prominent, a more or less concentric over-

growth of new, fibrous tissue, and this fibrosis, instead of being sharply defined toward the lobules of the organ, invades them, passing between the cells; so that there is developed a pericellular condition. With this the fibrosis is very general, so that not only do we have large bands inclosing several lobules, but in addition each individual lobule tends to be surrounded, and, more than that, bands of the new tissue may actually cut off portions of lobules; there is thus developed a unilobular cirrhosis, as contrasted with the multilobular appearance in portal cirrhosis. Another very characteristic feature of the condition is the appearance of the new, fibrous tissue; this tends to be more transparent than, and not so dense as, that seen in the ordinary portal form, while it is permeated by great numbers of bile-canaliculi.

Nature and distribution of the new tissue in cirrhosis of the liver: 1. In all forms of cirrhosis the white fibrous tissue is increased. 2. Along with the increase of white fibrous tissue there is a new formation of elastic tissue. This new elastic tissue is derived from pre-existing tissue in the adventitia of blood-vessels and the hepatic capsules. 3. Both white fibrous tissue and elastic tissue, in all forms of cirrhosis, may penetrate into the lobules. This penetration takes place along the line of capillary walls or follows the architecture of the reticulum. The chief distinctions between the histology of atrophic and hypertrophic cirrhosis depend upon the degree of extralobular growth and the freedom with which the lobules are invaded. In hypertrophic cirrhosis there would appear to be less interlobular growth and an earlier and finer intralobular growth. 4. The alterations in the reticulum, *per se*, consist, as far as can be made out at present, of hypertrophy rather than hyperplasia of the fibres. It is still uncertain whether any of the differential methods now in use suffice to distinguish between the reticulum and certain fibres derived from the

white fibrous tissue of the periphery of the lobules. Simon Flexner (Univ. Med. Mag., Nov., 1900).

As to the nature of the canaliculi, opinion is divided, some holding them to be of the nature of new formation from the pre-existing bile-ducts, others holding them to represent a late stage in the atrophy of the liver-cells. My own observations lead me strongly to support the latter view, for, in several sections in which they have been abundant, I have clearly made out the transition from the liver-cell to bile-duct.

From comparative anatomical grounds this would seem to be the most reasonable explanation of their development. That is to say, that following the successive stages of the evolution of the liver we find that in its earliest form the organ consists of a mass of independent finger-like follicles. Later these become joined together into a more solid mass, and with this a distinction can be made out between the lower duct-like portions and the secretory terminations of the follicles. Later again the cells become arranged more in reference to the blood-vascular system than to their primary connection as members of separate follicles. But still in the human liver the bile-capillaries must be regarded as the representatives of the lumina of separate hepatic follicles, and in peripheral atrophy of the lobules, where that atrophy is not extreme, the appearance which these sections present to me leads me to conclude that the secreting cells of the liver undergo what I have elsewhere termed "reversionary degeneration" (*vide* article on "Inflammation" in volume i of Allbutt's "System of Medicine"). The nuclei proliferate, and in place of obscurely arranged masses of typical liver-cells, we obtain small rows of cells resembling those of the bile-

ducts, with which they become continuous.

[In this connection it is interesting to note the presence of these new bile-canalliculi in cases of parenchymatous hypertrophy occurring in connection with portal cirrhosis and in the transitional cases between such hypertrophy and actual adenomatous development. J. GEORGE ADAMI.]

The general appearance of the larger bile-ducts, their abundant and proliferating epithelium, supports the view of Goluboff and some of the recent French observers, that we are here essentially dealing with a chronic diffuse catarrhal angiocholitis with chronic diffuse peri-angiocholitis. At the same time it may be that the liver-cells are also directly affected, and that there is here a replacement-fibrosis in addition to the inflammatory, for the character of the new connective tissue, especially at the margins of and invading the lobules, is not of a productive inflammatory type.

With regard to the other organs, the spleen is, in general, enlarged, and sometimes there is great enlargement. The lymph-glands are not found markedly enlarged; the kidneys and other organs of the body are bile-stained, but beyond that present nothing characteristic.

Symptoms.—Pain is felt in the region of the liver of a dull character, with some tenderness. While the general health appears to be fairly good and the appetite to be excellent, there is a slight fever and very characteristic is the development of a series of more acute attacks of abdominal pain resembling mild hepatic colic, associated with each of which the jaundice becomes more marked. Gradually the abdomen becomes enlarged, the enlargement being due to the increased size of the liver, which, on palpation, presents a perfectly-smooth surface. The process is, in general, of slow develop-

ment; only after months may the abdomen become markedly enlarged, and the enlargement may slowly continue for as many as eight years; but the jaundice is progressive and becomes so intense that the skin takes on a dark-green color. The jaundice is not obstructive, as shown by the fact that the stools continue to be stained. The urine, according to Hanot, shows slight diminution of the urea, is high colored, and contains abundant pigment. Throughout the disease there is absence of marked ascites, though in some cases there may be evidences of intestinal hæmorrhage. Sometimes there is a little fluid in the abdomen, and where this is the case it would seem to be associated with the development of peri-hepatitis and perisplenitis.

As the disease progresses, there is loss of strength, and with the progressive emaciation petechiæ may show themselves. Finally coma supervenes, and death occurs directly from the hepatic disturbance.

Thus, clinically the distinctions between this form of cirrhosis and ordinary portal cirrhosis are:—

1. The life-period at which the disease develops.
2. The enlargement of the liver and its smooth, or but slightly-roughened, surface (from perihepatitis).
3. The persistent jaundice.
4. The characteristic exacerbations of hepatic pain and of jaundice.
5. The absence of any marked ascites and of portal obstruction, save at the very end.
6. The preservation of an excellent appetite.
7. The long continuance of the condition after the recognition of the first signs of hepatic disturbance, and, associated with this, the slow emaciation and the retention of bodily strength.

It is all the more necessary to keep these distinctions in view, inasmuch as there is the painful confusion between this true biliary cirrhosis and those cases of portal cirrhosis in which there is the enlarged liver, either of the fatty type or again of the mixed, brought about by the indiscriminate employment of the term "hypertrophic." Nothing has more conduced to confusion with regard to cirrhosis than the employment of this term, and of the relative term "atrophic."

[Strictly speaking, the term *hypertrophy* of the liver should be employed to indicate an overgrowth of the specific liver-tissue,—i.e., of the parenchyma,—but ought never to be employed to indicate the overgrowth of the connective tissue of the organ, or the mere fact that the organ is enlarged. In short, he who wishes to make himself clearly understood will do well never to use the term in connection with the liver. Similarly if the term *atrophic* be banished the unity of the various forms of portal cirrhosis will be better grasped. J. GEORGE ADAMI.]

Seven cases of biliary cirrhosis in children, presenting all the symptoms observed in the adult, but with the addition, in many cases, of hypertrophy of the spleen. The latter, in association with biliary cirrhosis, is peculiar to cases commencing in childhood. In some instances the ends of the femur and tibia were also enlarged. Gilbert and Fournier (*Revue Mensuelle des Mal. de l'Enfance*, July, '95).

Case of Hanot's hypertrophic cirrhosis with chronic jaundice in which a very peculiar attitude of the body developed. The right shoulder was lower than the left, the right upper limb was also depressed, and the tip of the right middle finger was 4 centimetres below the corresponding point on the left side. The right side of the body, as a whole, was lower than the left, the right half of the pelvis and the right hip being depressed. The right gluteal fold was 2 centimetres below that on the left. There was no spinal curvature, and no anatomical le-

sion to account for it, and it appeared to be purely functional. Sicard and Remlinger (*Revue de Méd.*, Sept., '97).

Diagnostic points insisted on in cases of hypertrophic cirrhosis with icterus: (1) enlargement of the liver; (2) hepatoptosis, or downward displacement of the liver; (3) icterus; (4) discoloration of the fæces. In similar cases, but in which the fæces retain their normal color, Hanot's disease is characterized by persistent jaundice, enlarged liver (gradually increasing and slightly tender on pressure), great enlargement of the spleen, no clay color of the stools, and no ascites. Léopold Lévi (*Gaz. d. Hôp.*, Feb. 26, '98).

Prognosis.—To the best of our knowledge this disease is incurable, although it may be long years before death supervenes. A few cases have been recorded in which death has been of an acute course, occurring within a month. In one case recorded by d'Espine, in an infant, death occurred on the twenty-fifth day.

[I have, unfortunately, mislaid my notes upon this case. My memory of it is that this case is to be explained as a case of congenital obstruction of the bile-ducts, and as being more of the nature of the obstructive cirrhosis already referred to. J. GEORGE ADAMI.]

Treatment.—What has been stated concerning the treatment of hepatic cirrhosis would appear to apply, in a large measure, to the treatment of this form. Special care must be taken that the diet is bland and unirritating, because in severe cases errors in diet have appeared to induce the exacerbation above mentioned.

Stress laid on the importance and efficacy, at the outset, of calomel, together with milk diet. In the biliary form with intense jaundice, injections of salicylate of sodium, 15 to 30 grains to 1 pint of water, to be repeated daily. In addition, massage of the liver, cholagogues, appropriate diet, hot baths (with massage in the bath), and a course at an

alkaline spring. Liebreich (Practitioner, Apr., '94).

Pericellular Cirrhosis.

As already stated, the condition of pericellular cirrhosis exists to some extent in biliary cirrhosis, and in the so-called mixed type of portal cirrhosis a certain amount of pericellular or monolobular deposit of connective tissue is to be recognized. But there exist cases in which the pericellular change is microscopically the most-marked alteration in the organ, and, inasmuch as these cases are, in general, unaccompanied by either jaundice or ascites, it becomes necessary to treat them as a separate class.

We rarely, in the adult, meet with a generalized form of the disease. The most frequent examples are to be met with in the infant in connection with congenital syphilis. Not infrequently it is to be found well-marked in children born prematurely, whether alive or dead, close upon term. It may, however, be very evident during the first months of extra-uterine life, and where this is the case it often indicates a syphilitic intoxication so severe as to lead to death before the end of six months; rarely do the children survive if the hepatic enlargement is very extensive. Occasionally, however, there may be this diffuse pericellular cirrhosis in the adult, possibly, according to some writers, among whom may be mentioned Tzeytline (Thèse de Paris, '96), of the nature of a delayed hereditary syphilis, in which case it is associated with the presence of gummata; in other cases too, more rarely, it is a manifestation of acquired tertiary syphilis. I have seen one case of this in which in addition to the presence of numerous well-marked gummata, there was this general pericellular development of delicate connective tissue with

signs of progressive atrophy of the liver-cells. In this case, however, while the process was diffuse, it was most advanced in the neighborhood of the gummata, and there were areas in the liver showing relatively little fibroid change. Very rarely in tuberculosis there may be a similar pericellular change, though not so extensive as in syphilis.

In cattle, as first pointed out by Wyatt Johnston (Transactions of the American Veterinary Association, '93, and Appendix to Report of the Minister of Agriculture for the Dominion of Canada, '93), there exists in a strictly-limited region of Nova Scotia, around Pictou, a disease among cattle characterized by very extensive cirrhosis. The disease appears to be chronic, and death occurs after a brief period of acute delirium or from a progressive paresis passing on to complete paralysis with stupor. The disease most often is first recognized by the acrid taste and odor of the milk, which rapidly diminishes in amount, and with this, or earlier, the coat becomes "staring," the eyes prominent and very bright, and there is considerable looseness of the bowels. There is no jaundice and but a slight accumulation of fluid in the abdominal cavity toward the later stages. Upon killing the animal the main pathological changes are, in general, a moderate enlargement of the liver with some obtuseness of the angles; the surface is perfectly smooth. Microscopically there is marked evidence of parenchymatous and fatty degeneration of the cells, great diminution in their number, and replacement by a delicate and very transparent connective tissue, which in more advanced cases is to be found more dense and more concentrated around the intra-hepatic bile-ducts. There is no jaundice; indeed, in the twenty or so autop-

sies which were performed in this disease the gall-bladder was, in general, very full of bile or light color, the fæces were well stained, and, if anything, there appeared to be an excessive excretion from the organ.

Other well-marked features are the presence of a clear, limpid fluid in the abdomen (though this ascites is never excessive), a moderate enlargement of the abdominal lymphatic glands and of the glands at the hilus of the liver, and a peculiar gelatinous œdema of the coats of the fourth stomach and small intestines and of the mesenteries. In the fourth stomach, also, there are numerous follicular ulcers, generally found in a cicatrized condition. Studying this disease I constantly came across a minute bacillus presenting polar-staining, cultures of which were fatal to rabbits, guinea-pigs, and mice at periods varying, in rabbits, from a fortnight to a month, though in these cases the liver showed parenchymatous degeneration and almost singularly-slight early cirrhosis.

In some isolated regions in Germany and Switzerland the horses are said to suffer from a similar enzootic cirrhosis.

Anatomical Changes.—Leaving aside these cases of pericellular cirrhosis of the lower animals, and referring more especially to the liver of congenital syphilis in the infant, the organ here is found very greatly enlarged, so that in some cases its edge may reach to the iliac crest; the surface is smooth and of a deep-red color, though I have come across cases in which there was a coarsely-mottled appearance of relatively-large areas of bright-yellow color standing out against the red. Upon section the organ is fairly firm, and, microscopically, the main feature is this infiltration, between the hepatic cells, of delicate connective tissue with, however, a fair infiltration

of small, round cells, the hepatic cells showing evidences of marked atrophy. The portal sheaths are also greatly enlarged, and present considerable infiltration with small, round cells. There are, in general, evidences of the existence of miliary gummata, as minute small collections of round cells not very sharply defined are scattered irregularly through the organ; only in rare cases has the presence of occasional caseous gummata been noted.

Syphilitic livers in infants. The most common change in such cases was the one in which there are irregularly-distributed foci of degenerated liver-cells, with small-celled infiltrations. They eventually lead to the distorted syphilitic liver. In one case, however, the liver was almost normal in macroscopical appearance, but microscopically showed a wide-spread and intense, round-celled infiltration in the portal capillaries. This form probably passes into a genuine hypertrophic cirrhosis in later life. Marchand (*Cen. f. Allg. Path.*, No. 7, '96).

According to Hochsinger, four distinct main anatomical changes can be made out: 1. Diffuse small-celled infiltration. 2. Connective-tissue hyperplasia. 3. Miliary gummata. 4. Very rarely true nodular gummata.

Taking all these cases together, it is evident that this condition is distinctly of infectious origin, due, perhaps, not so much to the direct proliferation of the bacteria, for where that is the case, as in tuberculosis and syphilis, there is accumulation of small, round cells at the various foci of proliferation, but due to a toxic effect of the bacteria upon the liver-cells, the development of the fibrous tissue being secondary to the atrophy of the parenchyma.

Experimentally, according to Aufrecht, a somewhat similar interstitial or pericellular cirrhosis is producible by the action of small doses of phosphorus

frequently repeated. Such minute doses do not, like larger ones, lead to complete necrosis of the liver-cells, but the protoplasm becomes paler, the nuclei more evident and closer together, and the cirrhosis is diffuse and interstitial, exclusively due to the diseased hepatic cells more especially at the periphery of the acini. As is to be expected, poisons introduced into the system from without act like those developed within the organism (using this term in its broadest sense); so that some act primarily upon the intestinal walls and only secondarily upon the liver; others act directly upon the hepatic parenchyma, while all vary in their action according to their concentration.

Diffuse "interstitial hepatitis," leading to cirrhosis, is never the result of an interstitial inflammation; it depends entirely on an inflammatory process, affecting the glandular cells of the peripheral parts of the acini. Human cirrhosis corresponds exactly with experimental cirrhosis as produced by phosphorus. Aufrecht (*Deut. Arch. f. klin. Med.*, vol. lviii, p. 302, '97).

Symptoms (Syphilitic Pericellular Cirrhosis).—There seem no recognizable symptoms of this condition beyond the extreme enlargement of the liver, which is tender, and the co-existence of other evidences of the disease. There is, as above said, no ascites and no jaundice.

As above stated, this variety of cirrhosis frequently leads to intra-uterine death and to premature birth, and, where the child survives birth, death in general occurs before the sixth month. Where the enlargement of the liver is extensive, there appears to be little chance of recovery, though mercurial treatment has resulted in some recoveries.

Hochsinger (*Zur Kenntniss des Angeborenen Lebersyphilis der Säuglinge*," Vienna, '96) states that of 148 infants

with congenital syphilis, 46 showed clinical enlargement of the liver. The large number of 30 of these are stated to have recovered. Five cases came to autopsy, and in 1 the enlargement was due to tuberculosis. In none of his cases was there icterus or jaundice; in these enlarged livers there was some extent of fat-infiltration. He is strongly in favor of immediate mercurial treatment.

Arterial Cirrhosis.

Contrary to what I believe is the generally-received opinion, I find that in cases of general arteriosclerosis branches of the hepatic arteries resemble other arteries throughout the body in showing a distinct periarteritis

[Recently Hasenfeld (*D. Arch. f. klin. Med.*, '97) has noted similarly a slight chronic endarteritis in the hepatic arteries in arteriosclerosis. J. GEORGE ADAMI.]

This periarteritis is rarely extreme and clinically is incapable of recognition, though Eichhorst is inclined to recognize a senile variety of cirrhosis due thereto, and analogous to the arteriosclerotic nephritis resulting from arteritis and periarteritis in the renal vessels. This arterial change is only of interest in that a large proportion of subjects with alcoholic cirrhosis present also a condition of general arteriosclerosis, and thus associated with alcoholic cirrhosis there may be independently a certain amount of fibroid development in the portal sheaths due to the arterial disturbance.

Certain writers have suggested that the toxic substance leading to the development of what I have termed "portal cirrhosis" are brought to the organ by the arterial branches; if this be so, the anatomical evidence of the transmission is singularly small.

Centrilobular Cirrhosis.

In cases of well-marked obstructive disease, either of the heart or of the lungs, the liver is the seat of great, passive congestion, with atrophy of the central cells of the lobule. There is no sign of fibroid development in these regions; all that is to be seen is the great dilatation of the central capillaries of the lobule, with atrophy of the cells. In cases of a more chronic type with less severe obstructive disease we occasionally meet with a well-marked development of fibrous tissue immediately round the central vein of the lobule. It is debatable whether this is of the nature of a replacement-fibrosis in consequence of the atrophy of the central liver-cells or whether it may be termed "non-functional" or "non-inflammatory," due to the increased pressure in the hepatic veins and the altered character of the blood-flow. This form, again, while it may be predicated in cases of long-continued slight mitral or other obstructive disease, is associated with no clinical symptoms.

Hanot and Gilbert have, however, described a venous "hypertrophic" liver with enlargement, the organ remaining enlarged. If this form truly exists, it will be clinically impossible to differentiate it from the enlargement due to accompanying passive congestion.

Secondary Cirrhosis.

Synonyms.—Cirrhosis following upon perihepatitis; Glissonian cirrhosis; *zuckergeruss leber*.

While chronic perihepatitis may either be localized, and in patches over the surface of the liver, or generalized, it is with the generalized form that we have to deal in an article on "cirrhosis." Such generalized perihepatitis is a very characteristic condition pathologically, though clinically it may be present in an

advanced form without any signs of its presence, and, on the other hand, may ape and be almost, if not quite, indistinguishable from the atrophic and contracted form of portal cirrhosis.

Etiology.—Such thickening of the capsule of the liver may be one of the results of a general peritonitis; indeed, it must be regarded as one evidence of such a condition.

Of 22 cases of universal perihepatitis in the post-mortem records at Guy's Hospital collected by Hale White (Allbutt's "System of Medicine," volume v, p. 118), in only 2 was it stated there was no peritonitis; in 17 it was distinctly stated to be present, and in the remaining 3 no mention was made of the peritoneum. Hale White suggests that in his cases the peritonitis was always fibroid and so never owed to tubercular growth; this, however, is contrary to the observations of other writers, and I myself have seen a most-marked condition of universal perihepatitis accompanying and evidently due to a chronic peritoneal tuberculosis, though it is true the thickened capsule in such case does not show a characteristically tubercular appearance throughout, but is fibroid in its deeper layers and homogeneous. But a study of chronic tuberculous pleurisy shows that the process may assume this homogeneous fibroid character. In fact it may be said that this form of universal fibrous perihepatitis is distinct from localized chronic perihepatitis in that it is an extension of inflammatory disturbance from without the liver, and not from within, as may often happen in the latter condition, and that anything capable of setting up a chronic productive inflammation in the abdominal cavity is also capable of producing this form of disease.

Pathological Anatomy.—In conse-

quence of the deposit of this thickened, new, fibrous tissue over the surface of the organ and its contraction, the liver becomes more globular in appearance than normal, though it is to be noticed that, in general, the thickening is more marked on the upper and anterior surface than on the under surface. Frequently, as Fagge, I believe, was the first to point out, the anterior edge is folded over on to the dorsum in a manner that is difficult to explain. Frequently, also, the omentum, shortened and thickened by the universal peritonitis, is adherent to the lower edge of the organ; and this thickened mass may be mistaken for the edge of the liver. Frequently, again, the productive inflammation on the surface leads to adhesions, more especially anteriorly and to the diaphragm.

As Hale White points out, often little pits are to be seen on the surface of the thickened capsule; when seen they are very striking. I have only seen them upon the upper diaphragmatic aspect of the organ in regions where there have been no adhesions, and from their position and character I am inclined to believe that they are brought about by little eddies opposite to the lymph-stigmata in the under surface of the diaphragm. A marked feature is the ease with which the thickened capsule can be peeled off, leaving, in general, a smooth surface.

Authorities differ as to the connection between this perihepatitis and cirrhotic change in the organ itself. According to Murchison and Osler, it is frequent, but Fagge, Hale White, and Curschmann (*Deut. med. Woch.*, p. 564, '84) speak of the condition as, in general, unaccompanied by any interstitial inflammation. And, in the not very frequent cases which I have come across,

I also have found the liver soft and pulpy, rather than fibroid. Evidently both conditions may exist, and, speaking correctly, it is only the former condition where there is this extension of the inflammatory process inward along the lymphatics, leading to the development of fibrous bands within the organ; or, again, where there is an extension upward of the process into the organ along the sheaths of the portal vessels at the hilus, which ought properly to be spoken of as cirrhosis.

With regard to other organs. The spleen, in general, shows a like capsular thickening, more especially of its diaphragmatic surface, and, as Hale White, who has made the fullest study of the condition, points out, there is a very frequent complication of interstitial nephritis.

Symptoms.—Frequently, as above stated, there are no symptoms recognizable; but, in a typical condition of the disease, we find the liver smaller than normal, with thickened uniformly blunt edge, and, associated with this, marked ascites.

Hale White points out that the condition is of long duration, and that the ascitic fluid can be repeatedly tapped. There is an absence of jaundice, while evidences of chronic peritonitis and, again, of interstitial nephritis, are well marked.

At times a friction-sound can be made out over the liver, though this is rare; more frequently the organ, by adhesions to the abdominal wall, becomes fixed and it does not move downward on inspiration.

In London apparently this condition is fairly frequent, for Fagge makes the statement that, at Guy's Hospital, for every five cases that die showing portal cirrhosis with ascites there is one in

which the ascites is associated with perihepatitis.

Treatment.—Where there is such extensive perihepatitis, treatment cannot be curative, but can only be palliative, and, of palliative measures, tapping is the most important.

Sporadic Cirrhosis.

I would employ the term "sporadic cirrhosis" to indicate those cases in which there is a fairly-extensive development of fibrous tissue throughout the liver in scattered patches related definitely in origin to no one special portion of the lobule or of its surrounding sheath. Where the development is slight, we can scarcely speak of cirrhosis; but in some cases the connective-tissue development may be very extensive, and here we must speak of cirrhosis.

Two main series of cases are to be included under this heading:—

1. The fibrous-tissue development in consequence of the presence of multiple infectious granulomata: a condition seen in tuberculosis and syphilis.

2. The condition to which our attention has been more especially directed by Welch, Flexner, Barker, and the Johns Hopkins School, in which, apparently from the action of toxins rather than from bacteria, multiple focal necroses are developed in the liver. These focal necroses pass through the successive stages of slow death, infiltration with leucocytes, and organization and formation of fibrous tissue, leading eventually to the development of fibrous tissue; so that scattered through the organ are little, irregular nodules of fibrosis.

Yet a third form may be recognized, for the recognition of which we are again indebted to Welch, namely: that form of cirrhosis due to the conveyance into the liver by lymph or blood of discrete particles of foreign matter, as, for example,

of carbon or of stone. Around about such little collections of foreign particles there may be developed here, as in the lung, a noticeable amount of fibrous tissue; but, in general, the condition is very slight.

I have come across it both in connection with anthracosis and again in connection with stone-mason's lung, or silicosis; but to the best of my belief Welch's well-known case of cirrhosis anthracotica is the only very extensive and truly cirrhotic case upon record.

1. CIRRHOSIS DUE TO INFECTIOUS GRANULOMATA.—In general, tuberculosis affecting the liver leads to no recognizable symptoms, even though the liver be thickly studded throughout with fibroid tubercles; very rarely we have a caseous mass. Beyond, therefore, mentioning the existence of this form, it is unnecessary for me to say anything further concerning it.

With syphilis it is different. Here dense bands of new tissue may radiate in various directions around the fibroid and caseous gummata. Where these gummata are frequent, the obstructive effect of the bands and again the deformity of the organ may lead to signs and symptoms which closely simulate either the atrophic or parenchymatous hypertrophic form of portal cirrhosis. But even in the most extensive cases the development of this fibrous tissue is so sporadic, and the condition of the other parts of the organ is so relatively healthy, that, strictly speaking, these cases ought not to be spoken of as cirrhotic.

For its symptomatology, this gummatous form depends upon the number and the position of the gummatous growths in the organ and the amount of fibrosis developed in the immediate neighborhood. As these gummata have no points of election and may occur on the upper

surface and away from the vessels at the hilus as frequently as they occur in its neighborhood, it follows that we may have, on the one hand, an advanced gummatus condition of the organ unaccompanied by jaundice or by ascites or by any recognizable disturbance; while, on the other hand, there may be but a few gummata, and yet these, being situated in such a position as to obstruct either the main branches of the portal vein or some of the main bile-ducts within the organ, may induce either ascites or icterus, or both. In advanced cirrhosis, where there are numerous gummata, it may be possible to palpate the lower portion of the organ, and to recognize the scarred and coarsely-nodular condition of the surface; or, again, as in advanced portal cirrhosis, the organ may be, by the contraction of the fibrous tissue, so retracted behind the ribs as to be incapable of being felt. Where this is the case, it is impossible to make a diagnosis between tertiary syphilis and the liver of alcoholic cirrhosis, unless the evidence of syphilitic infection of other organs is present. Where there is doubt as to the nature of the condition, progressive improvement manifested under the potassium-iodide treatment will clear up the diagnosis. Osler distinguishes a group of cases in which the patient is anæmic, and passes large quantities of pale urine containing albumin and tube-casts; the liver is enlarged and, perhaps, irregular; and the spleen also is enlarged; while ascites may supervene. In such a case the presence of gummata is associated with amyloid degeneration of the organ, of the intestinal mucosa, and of the spleen. He further points out what is, perhaps, not very uncommon: that the large projecting masses of liver-tissue produced by the contraction of

gummata affecting the left lobe are apt to be mistaken for new growths occurring in connection with the organ. Here, again, potassium iodide affords valuable aid in diagnosis.

In brief, the history of syphilitic infection, and the effects of treatment by potassium iodide, are the main diagnostic aids in differentiating syphilitic or other forms of cirrhosis.

2. THE CIRRHOSIS OF FOCAL NECROSES.—As yet we know and pathologically have been able to recognize singularly few cases of cirrhosis originating from focal necroses. Such focal necroses occur in a large number of infectious diseases. Not only have they been recognized by Welch and Flexner in diphtheria, by Reed and subsequent observers in typhoid fever, and by numerous observers in tuberculosis, but by Guarneri, Thayer and Hewetson, Barker, and others in malaria; and Flexner, in his experimental work upon toxalbumins, has been able to show that several vegetable poisons of the nature of toxalbumins will produce them and follow the development of cirrhosis following upon these focal necroses.

[Hanot (Comptes-rendus de la Soc. de Biol., p. 469, '93) describes as *taches blanches du foie infectieux* certain appearances which, he points out, characterize the liver in all forms of infectious disease; small irregular areas of pale color, appearing more especially on the convex surface, in which upon microscopical examination a condition of dilated capillaries with abundant intravascular and extravascular leucocytes are to be made out. The liver-cells in the regions show degenerative changes. The condition is allied to the focal necroses. J. GEORGE ADAMI.]

As to the exact causation of the necroses, some doubt must, I think, still be expressed. While it is possible that, as many observers believe, they are directly

due to the action of toxins, it is difficult to comprehend why such toxins should pick out only specially-isolated portions of the organ. One would expect to find that in addition to the action of the toxins there is some disturbance of the circulation, some thrombosis, or other change in the smaller veins or capillaries of the part, whereby the cells, being imperfectly nourished, undergo destruction.

[A full and interesting discussion of the matter is to be found on page 386 of Flexner's remarkable monograph ("The Pathology of Toxalbumin Intoxication," Johns Hopkins Hospital Reports, vol. v, '97). Barker, in his studies upon malaria, and Schmorl, in puerperal eclampsia, have drawn attention to the existence of intracapillary thrombi in connection with these areas of necrosis. Flexner in his ricin experiments was forced to conclude that there is no causal relationship between the thrombi and the necroses, and that the localized cell-death is due to the intensity of action of the toxic bodies upon the tissue-elements and not upon the circulating blood or its channels. J. GEORGE ADAMI.]

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CLEFT PALATE. See PLASTIC SURGERY.

CLITORITIS.—Latin, from Greek, *κλειτορίς*, to titillate; and *itis*, inflammation.

Definition.—The question as to the frequency of this condition is one which involves great difference of opinion, and depends not a little upon the definition which one gives to it. If it is considered as an inflammation which involves the structures, as a whole, of which the organ is composed, it is, indeed, of rare occurrence; but if we include that adventitious form of inflammation, often of slight intensity, indicated by fibrous structures which are attached to and

bind down its terminal portion, it is of great frequency. If all female children were carefully examined to determine its presence or absence it would doubtless be recognized much more frequently than it is. It would probably be found as often as the analogous condition which affects the penis of male children.

Symptoms.—The venereal variety of clitoritis may be associated with either of the forms of venereal infection; that is, with chancre, chancroid, or gonorrhœa. True chancre of the clitoris is of rare occurrence. In a dispensary experience of many years among women with every shade of venereal disease I do not recall a single instance.

Dr. R. W. Taylor has informed me that he has seen it several times, and that it was characterized by great pain, swelling, and induration, and reported a typical case in a woman, 21 years of age, who contracted syphilis from her husband. The clitoris and prepuce were indurated, enlarged, and very painful, and there was an ulcer at the tip of the glans. Local treatment with solution of caustic potash and lead-and-opium lotion produced relief. Other cases have been reported by Mauriac.

Chancroid of the clitoris I have seen several times, though Taylor thinks it is of rare occurrence. Its phenomena are those of chancroid on other portions of the female genitalia, viz.: local sore without great attendant hyperæmia in the structures of the clitoris, and usually enlargement of the neighboring inguinal glands.

Gonorrhœa involving the clitoris is not of infrequent occurrence. The phenomena are redness and swelling of the prepuce and to a greater or less degree of the organ itself; the accompanying pain may be considerable. Traumatic clitoritis is relatively of rare occurrence. It

is the result of direct injury from violent coitus, from a blow, a thrust, or a fall, the clitoris sharing injury with the surrounding structures. The inflammation follows the course of inflammations of a traumatic character in similar vascular tissues, pain and swelling being the most prominent features.

Etiology and Pathology.—It is somewhat surprising that inflammatory phenomena of a decided character are not more frequently connected with the clitoris when we remember its exquisite sensitiveness, its abundant blood-supply, and its constant exposure to irritation during the entire period of life in which the tissues of the genital organs are in an active functional condition. During childhood its conspicuous position invites the injuries to which childhood is unusually susceptible, and it is also in danger from uncleanness, from parasites, and from masturbation. After the external genitals have acquired complete development and the mature condition which follows puberty has placed the organ in a less exposed situation there is still danger from traumatism, though not to a great degree; from uncleanness, from masturbation, from violence in coitus, and from the poisonous influence of venereal disease. It would seem that the susceptibility to injury increased with the size of the organ, a large organ being an anomaly and requiring constant care and precaution. This fact emphasizes the necessity that the family physician be acquainted with the peculiarities of his patients in order to safeguard them from evils which may be avoided.

The clitoris may be the seat of cystic disease from hæmorrhage or other cause (Peckham), of syphilitic new growth (Kelley), of carcinoma (Robb), of hypertrophy, in addition to various congenital

deformities and defects. Its appearance in spurious hermaphroditism is a very good illustration both of hypertrophy and of congenital deformity. These statements are made incidentally, since a true inflammation may be associated with either of these conditions, a true clitoritis being then present.

Inflammatory disease of the clitoris may, therefore, be prenatal or postnatal in its origin, congenital or acquired. In the great majority of cases it is prenatal; that is, it originates during fetal life. Why such a condition should arise so frequently during this period is not known; but the fact remains that many female children come into the world with the glans clitoridis surrounded by more or fewer bands of adhesion, binding it down, interfering with its circulation and development, and furnishing cause for more or less subsequent irritation and disturbance.

Of the postnatal, or acquired, form of the disease, while there are occasional instances in which it is caused by uncleanly habits, by parasites, and by the extension of dermatitis affecting the contiguous tissue, in the greater number of cases it will be due to venereal infection or to traumatism.

With reference to its etiology, therefore, the disease may be classified as (1) congenital, (2) venereal, and (3) traumatic.

Of the causes of the congenital variety we are ignorant, as has already been remarked.

The bands and strands of fibrous tissue of greater or less density and firmness, which are its visible consequence, attach its glans to its prepuce, or hood, which is formed by the coalescence of the nymphæ, and to the surface which lies immediately around it. The contraction of this tissue, according to its abun-

dance and firmness, interferes with the development of the organ, produces irritation, and probably leads, in not a few instances, to the habit of masturbation. It is conceivable, as Baker Brown insisted, that certain forms of nervous disease might result in consequence of such conditions, but the number of cases in which such a relationship has been carefully observed must be quite small. In the great majority of cases it is believed that the resulting disturbance has been too slight to require attention and treatment from the gynæcologist.

Treatment.—There is little to be said concerning the treatment of clitoritis of whatever variety.

Rest in bed is essential; local cleanliness equally so. In the congenital variety the adhesions must be removed, and this can usually be done by retracting the prepuce with the thumb and forefinger of one hand while the forefinger of the other is rubbed over the glans with sufficient firmness to remove all obstructions. The bruised surface may then be dusted with iodoform, aristol, or nosophen, and this process repeated daily as long as the surface remains broken. For the venereal variety a 10- or 20-per-cent. solution of nitrate of silver should be applied daily upon absorbent cotton until pain and swelling have subsided and the ulcerated surface has healed. For the traumatic variety only soothing lotions will be required. Lead-and-opium wash, frequently applied upon absorbent cotton, will serve the purpose sufficiently well.

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CLUB-FOOT. See ORTHOPÆDIC SURGERY.

CLUB-HAND. See ORTHOPÆDIC SURGERY.

COCA AND COCAINE.

Erythroxyton coca is a small tree that grows wild in Peru, Bolivia, Brazil, and Ecuador. The leaf, which contains the active principles, is the part used in medicine. Three alkaloids, hygrine, ecgonine, and cocaine have been isolated from the cocoa-leaves. Cocaine, the only one that has been found useful in medicine, occurs in colorless, transparent crystals, which are soluble in alcohol, ether, chloroform, and fats. Cocaine forms salts with the acids, the hydrochlorate being official and the one usually used. The salts cannot be used for making ointments, as they are soluble in fats.

Preparation and Dose.—Coca (leaves), $\frac{1}{2}$ to 1 drachm.

Extractum cocæ fluidum, $\frac{1}{2}$ to 2 drachms.

Cocaine carbolate, $\frac{1}{12}$ to $\frac{1}{6}$ grain.

Cocaine hydrochloras, $\frac{1}{4}$ to 2 grains.

Coca is best administered either as a tonic or coca, such as vin Mariani, or in the form of the fluid extract. When administering coca or cocaine the possibility of intolerance on the part of the patient should be borne in mind and the danger of inducing the cocaine habit remembered. Solutions of cocaine hydrochlorate are bitter, and provoke transient insensibility of the tongue. Aqueous solutions do not keep well, but decompose in a short time and lose their efficiency.

Series of experiments indicating (1) that chloral-hydrate is a decided antagonist of cocaine, being able to counteract the action of doubly-lethal doses given to a dog; (2) other hypnotics, such as paraldehyde, are likewise antagonistic to cocaine; (3) the antagonism is complete, influencing all the important organic functions; (4) it is a one-sided antagonism, for cocaine does not counteract poisoning by the hypnotics; (5) the antagonism is a mechanical one, similar to the antagonism be-

tween the hypnotics and strychnine. Carlo Gioffredi (*Giornale Inter. delle Scienze Med.*, Aug. 31, 1900).

Physiological Action.—When taken internally, coca and its alkaloid produce a sensation of exhilaration and pleasure similar to that produced by a large dose of caffeine. There is a marked tendency to wakefulness, a feeling of increased mental and muscular strength and vigor, and an absence of hunger. The brain is stimulated, but the sensory nerves are not generally affected, and, if at all, the effect is very feeble and is due to an influence on the spinal cord (Mosso). When applied locally to the sensory nerves cocaine paralyzes them. This also happens if the internal dose be very large. The effect upon the muscles when taken internally is direct stimulation, most marked after fatigue.

Maurel, of Toulouse, has shown that under the influence of cocaine the leucocytes undergo changes; they become spherical and rigid, increase in size, and no longer adhere to the vessel-walls. On the other hand, the capillaries contract, and thrombosis and embolism—particularly pulmonary embolism—may be produced.

Upon the heart and circulation cocaine in moderate amounts acts as a stimulant, the heart-beats being increased in number and force; but marked effects only follow a poisonous dose. Cocaine is a respiratory stimulant, large doses increasing the number of respirations; in poisonous doses it kills by failure of respiration associated with exhaustion from the accompanying convulsions (Hare). Cocaine increases body-heat to a marked degree if given in overdose, this rise being due to increase of heat-production (Reichert). When applied locally to mucous membranes, cocaine produces an anæsthetic effect, accom-

panied with a blanching of the membrane, followed by a marked congestion. When injected beneath the skin cocaine produces a local-anæsthetic effect. Applied externally to the skin it produces little effect.

The rise of temperature caused by cocaine is due to an increase of heat-production, and the latter depends upon two actions: one, of the cortex, causing motor excitement, and the other, upon the caudate thermogenic centre, by which heat is produced independently of motor activity. Cocaine possesses very little power as a thermogenic in animals lightly curarized, because of both the motor quietude and the depression of some other portion of the thermogenic apparatus. It is absolutely without thermogenic power in animals in which the pathways of thermogenic and cortico-spinal motor fibres have been cut, as after section of the spinal cord at its junction with the bulb and of *crura cerebri*. Cocaine is effective as a thermogenic when only a small portion of the caudate centre is left intact with the parts below. Cocaine and morphine are direct antagonists in their actions upon the caudate and cortical centres which are directly or indirectly involved in the changes of temperature and heat-production. E. T. Reichert (*Phila. Med. Jour.*, Aug. 2, 1902).

Poisoning by Cocaine.—**ACUTE POISONING.**—When cocaine is given in poisonous doses the symptoms noticed are an exaggerated sense of mental and physical well-being, loquacity and mental incoherence, profuse diaphoresis, fall of temperature; shallow, irregular breathing; dilated pupils, disturbed vision, nausea, feeble pulse, and finally collapse.

Epileptiform convulsions have also been noted with disordered circulation and respiration; the convulsions, both tonic and clonic in type, are of cerebral origin.

Smallest hypodermic dose observed to produce faintness and nausea was $\frac{1}{10}$

grain: in the case of a man aged 65. Old people are especially susceptible, and it is advisable in every case to have brandy and amyl-nitrite at hand. J. Jackson Clarke (*Lancet*, Jan. 18, '96).

Case of acute cocaine poisoning, an injection of $\frac{3}{4}$ grain of the drug for relief of severe pain being given. Within five minutes the pain had all disappeared. The next day $\frac{1}{2}$ grain only was injected; within three minutes there was a faint feeling, with collapse, followed by rapid heart-action and respiration; after ten minutes clonic contractions with widened pupil, bulging globes, and other severe symptoms. These passed off, and by the next day the man was out. The pain, which had been of long standing in the region of the hip-joint, did not return. Bergmann (*Münchener med. Woch.*, Mar. 20, 1900).

Instance of the toxicity of cocaine. A strong man, aged 46, was seized with severe epistaxis, which recurred in spite of treatment. The bleeding came from a spot in the floor of the left nostril. Two applications of a 10-per-cent. solution of cocaine were made to this, resulting in an alarming attack of an epileptiform nature, the clonic spasms continuing for nearly ten minutes. The epistaxis ceased during the convulsions, and did not recur. Kohn (*Med. Record*, Mar. 24, 1900).

Case under treatment for the morphine habit, who was known to be very susceptible to cocaine, received by the mouth, 30 milligrammes (nearly $\frac{1}{2}$ grain) of that substance. The pulse, which was normally weak and never faster than 80, rose to 104 and became hard and tense. A noticeable feature was the enlargement of the outline of the heart, with marked palpitation, which occasioned much alarm to the patient. The case terminated in recovery. J. Hofmann (*Therap. Monats.*, No. 11, 1901).

Thus we have two phases of acute poisoning; one with symptoms of depression, the other convulsive in type.

CHRONIC POISONING.—Chronic poisoning by cocaine, or the "cocaine habit," occurs sometimes alone, some-

times associated with the opium habit. The symptoms after cocaine habit consist of marked loss of body-weight, disordered circulation, loss of mental power and moral perception, and delusion, similar to those affecting the subjects of chronic alcoholism. (See **COCAINOMANIA**.)

Treatment of Cocaine Poisoning.—The treatment of acute poisoning where the symptoms are those of depression consists in the exhibition of sal volatile, coffee, strychnine, caffeine, digitalis, ether, and alcohol. If the symptoms are of the convulsive type, the treatment should be the same as that of strychnine poisoning: inhalations of amyl-nitrite, bromides with chloral; if convulsions prevent swallowing, use chloroform anaesthesia and give antidotes by rectum in starch-water. Amyl-nitrite and morphine by hypodermic injection are indicated if relaxation does not occur.

From experiments upon animals in regard to lavage of organism in acute cocaine poisoning, the following deductions made:—

1. While the minimum fatal dose of cocaine muriate administered hypodermically is 0.025 gramme per kilogramme, one can inject, of the same drug, without fatal result: (a) gramme 0.03, if we follow the said injection with hypodermoclysis; (b) and 0.035 gr. per kilogramme if we follow the said injection with lavage of the organism by the injection of the physiological solution of sodium chloride.

2. While the minimum fatal dose of cocaine muriate administered fasting by the alimentary canal is $3\frac{1}{2}$ centigrammes per kilogramme, one can, with lavage of the organism, administer as much as $5\frac{1}{2}$ centigrammes per kilogramme without fatal results. Carlo Bozza (*Gior. Internaz. delle Sci. Med.*, Feb., '98).

Therapeutics.—The therapeutics of this drug may be conveniently treated under three heads: the internal, hypo-

dermic, and topical administrations. Coca and cocaine are contra-indicated in fatty heart, arterial atheroma, pernicious anæmia, hysteria, and epilepsy.

The first and greatest precaution to be taken before the hypodermic injection is the preliminary physical examination; this should be made with the utmost thoroughness; if the patient is suffering with organic disease of the brain, heart, lungs, or kidneys, or any confirmed neurotic disorder, injection of the drug must not be attempted. The patient should be placed in a recumbent position, with the head low, and he should not be allowed to rise for at least fifteen minutes after the cocaine has entered the general circulation. Where it is possible to use constriction, it should never be omitted. After the operation, tourniquet is loosened and immediately tightened. This is repeated at intervals of a few minutes until the cocaine has probably all entered the circulation. C. A. Dunmore (Codex Medicus, Dec., '95).

Cocaine administration in medical practice can be rendered absolutely safe by refusing its use in persons with kidney and heart affections, and the employment of means which will fortify against the possible occurrence of accidents. Accidents can be avoided by the administration of morphine and atropine. Oxygen-gas is the only true antidote. Charles Wilson Ingraham (Med. News, Jan. 22, '96).

Internal Administration.—For internal administration the fluid extract of coca or a good coca-wine, such as vin Mariani, is preferred. The elixir and tincture are not sufficiently active or reliable.

Cocaine successfully used in several cases of seasickness. A cathartic was first administered, then 5 minims of a 4-per-cent. solution of cocaine repeated every hour or two until three doses were taken. A. D. Rockwell (Med. Record, Apr. 1, '96).

FEVER.—The stimulating and supporting effects of coca are well known and may be utilized in all forms of low

fever. In yellow fever it is of especial value on account of its anti-emetic property.

VOMITING OF PREGNANCY.—Coca has been found useful in many cases of this distressing malady and in other forms of vomiting. From $\frac{1}{2}$ to 1 wineglassful of vin Mariani or 1 to 2 tablespoonfuls of the fluid extract may be taken three or four times daily, preferably after meals, so as not to impair the appetite.

FATIGUE.—In persons suffering from fatigue, coca is found to rest and freshen the mental and physical powers, giving a feeling of comfort and well-being, and making possible the endurance of further work and strain. To those who are about to undergo unusual strain or fatigue, coca acts as a powerful stimulant. Overindulgence in this use of coca is strongly advised against, in view of the danger of forming the habit.

OPIUM HABIT.—Coca has been employed as a stimulant during the withdrawal of the opium, but its use is not without the danger that the one habit may be replaced by the other, or, indeed, become associated with it.

In any case of opium poisoning an emetic should be first employed; then hypodermically $\frac{1}{4}$ to $\frac{1}{2}$ grain of cocaine. If after twenty minutes no decided effect has been obtained, another injection of $\frac{1}{4}$ grain should be given. Three separate doses of $\frac{1}{4}$ grain each, at intervals of twenty minutes, is the best plan to follow. During this time coffee by mouth or rectum to be administered. J. W. Stickler (Langsdale's Lancet; Med. and Surg. Reporter, May 28, '97).

PYLORIC CARCINOMA.—Cocaine carbolate has been used with success in these and other cases where a combination of an anæsthetic and antiseptic was desired. The dose used was $\frac{1}{12}$ to $\frac{1}{6}$ grain in wine or diluted.

NERVOUS DISORDERS.—In melan-

cholia and neurasthenia coca has been used with advantage, especially when associated with a moderately-anæmic condition, a feeling of depression, loss of appetite, and impaired digestion, other appropriate remedies being associated with it. A wineglassful of coca-wine every three hours usually brings about a beneficial change in a day or two.

Hypodermic Administration.—For hypodermic use the salts of cocaine are used (generally the hydrochlorate), as the alkaloid requires 1300 parts of water for its solution. A 4- to 8-per-cent. solution is generally employed, and not more than $\frac{1}{4}$ grain of cocaine should be injected.

Solution employed by writer contains 10 per cent. of resorcin and 20 per cent. of the hydrochlorate of cocaine. The addition of resorcin diminishes the toxic effect of cocaine, while at the same time it increases the anæsthetic effect of the latter, and it moreover prevents the cocaine crystallizing out. The antiseptic properties of resorcin in the solution are also of value. Use of the spray for applying cocaine to the nose disapproved of. If after the application of a solution of cocaine the patient becomes pale, giddy, or faint, 1 drachm of the aromatic spirit of ammonia, in 2 ounces of water, should be given, and the patient directed to sip the draught. F. de H. Hall (Brit. Med. Jour., Feb. 8, '96).

Extra care should be observed and a smaller dose given where injections are made about the head, face, and neck. The hypodermic use of cocaine is employed to relieve pain, and to induce local anæsthesia for the purpose of making some surgical operation.

NEURALGIA.—Sciatica, pleurodynia, etc., and all forms of muscular rheumatism are best treated by hypodermic injection. For all, except neuralgia of the head and face, $\frac{1}{4}$ to $\frac{1}{2}$ grain should be injected over the seat of the pain; for

the two latter, the injection should be made into the arm.

In lumbago, sciatica, pleurodynias, all forms of muscular rheumatism, $\frac{1}{4}$ to $\frac{1}{2}$ grain of cocaine injected over the seat of pain followed by excellent results. In neuralgia of head and face injection should be into arm. Injections continued as long as the pain lasts. G. H. Seagrave (Brit. Med. Jour., Feb. 8, '96).

The result is marked in nearly all cases. The pain disappears almost entirely for several hours, when, if it return, it is in a milder form. Injections should be continued as long as the pain lasts.

Cocaine anæsthesia is contra-indicated in all irregular and all great operations, as well as in abdominal surgery. Its principal use is in weakened subjects affected by organic taints or otherwise. The cocaine should not be allowed to enter the general circulation.

Local Anæsthesia.—Several methods of producing local anæsthesia by the hypodermic use of cocaine have been suggested other than the simple one employed in medication with other remedies.

The painless method is one in which, after the part to be injected has been subjected to antiseptic cleansing, the part is sprayed with rhigolene or ethyl-chloride until insensibility to pain is induced. The point of the needle is introduced just below the epidermis and a drop or two injected into the tissues. This produces an area of insensibility within the edges of which other injections are made, gradually increasing the extent of the area of insensibility. Corning, who suggests this method, advises the injection of the subepidermal region first, and subsequently the deeper tissues.

The endermic method consists in first producing a small blister, withdrawing the serum therefrom with a syringe, and replacing it with a solution of cocaine.

This method has no practical value in surgery.

PROLONGATION OF LOCAL ACTION OF COCAINE FOR SURGICAL PURPOSE.—By arresting the arterial and venous circulation, Corning has demonstrated that when cocaine is injected into an extremity its action may be prolonged for ninety minutes, if necessary. This arrest he accomplishes by the aid of appropriate ligature about the limb, or in the case of the breast or back by the application of rings, clamps, etc. He maps out the veins (to avoid puncture) by tying a piece of elastic webbing above the field of operation. As the veins become swelled he traces their course with a colored pencil and then removes the webbing. The limb is next exsanguinated with an ordinary Esmarch bandage carried up to (but not beyond) the field of operation and maintained in place till the injections of the anæsthetic are completed. A strong flat tourniquet is then applied about the limb *above* the field of operation and drawn tight enough to interrupt the circulation in the vessels. The Esmarch bandage is then removed, and the field is ready for operation.

Case in which Esmarch's constrictor was applied immediately above the malleoli; a solution of cocaine (1 per cent.) was then injected in the position of the different nerve-trunks, a number of different punctures being made with the needle. After an interval of three-fourths of an hour, the operation took place; this consisted in the removal of the great toe, its metatarsal bone, and of the cuneiforms, in addition to scraping with the sharp spoon and stitching of the skin. During the hour employed in these procedures, the patient was quite unaware of their progress. It is essential, in all cases in which it is desired to completely anæsthetize the hand or foot, that the rubber tourniquet be very firmly applied, and that a sufficient interval (not less than twenty minutes) be allowed to elapse between the injec-

tion of the cocaine and the operation. Otto Manz (Centralb. f. Chir., Feb. 19, '98).

Case in which an abdominal section was performed under cocaine anæsthesia for retroverted adherent uterus, owing to marked cardiac symptoms and goitre. Eight minims of 5-per-cent. solution of cocaine having been injected beneath the skin, an incision was made in the median line down to the muscle-sheath. Eight minims more were injected at different points along the median line into the muscular structures, and the incision was then carried into the peritoneal cavity. The adhesions binding the uterus down to the rectum were then separated without any apparent discomfort to the patient. But even slight traction upon the ovaries seemed to produce considerable pain. The uterus was brought forward and stitched according to the ordinary suspension method. The peritoneum was closed by means of a continuous catgut suture. The patient made an uninterrupted convalescence. Hunter Robb (Cleveland Med. Gaz., Feb., '99).

Amputation under cocaine anæsthesia in a case of gangrene of the foot, the patient being too weak to take a general anæsthetic. The limb was encircled with a broad elastic band, and two injections of cocaine solution made in the region of the main nerve-trunks. After waiting thirty minutes amputation at the knee was carried out almost painlessly. Berndt (Münchener med. Woch., July 4, '99).

THERAPEUTIC THROMBOSIS.—This is a method also devised by Corning for the localization and prolongation of the action of cocaine. Four principles are embodied in the procedure:—

1. Injection of the anæsthetic (cocaine) into the skin.
2. The subsequent introduction through the same hypodermic needle, and without its removal from the part, of a non-irritant oil (cocoa-butter).
3. Precipitation of this oil, after its injection into the skin, by the aid of

moderate cold, but without freezing the tissues.

4. Taking up the slack of the skin near the seat of the injection, should the integument be very elastic. By the application of these principles he has succeeded in maintaining a limited zone of anæsthesia for considerably over an hour.

INFILTRATION ANÆSTHESIA. — This method of local anæsthesia was devised by Scheich, of Berlin, and employed by him in all kinds of operations, including laparotomy. He uses a weak solution of cocaine (1 to 1000), the solvent being a saline solution (of 0.2- to 0.3-per-cent. sodium chloride). A small spot on the skin near the field of operation is sprayed with ethyl-chloride, and when insensible to pain is injected with a few drops of the cocaine solution. At the spot of infiltration a wheal immediately arises, which is absolutely without sensation. Pushing the point of the syringe farther under the skin through this area of insensibility a few drops are again injected.

Another wheal rises close to the first, and by extending these injections farther and farther round the field of operation, the whole is infiltrated and rendered anæsthetic. The injection must always be made into healthy skin, otherwise a slough is likely to follow. The formula generally used is as follows: Cocaine hydrochlorate, 2 grains; sterilized distilled water, 4 fluidounces; sol. carbolic acid (5 per cent.), 3 drops.

The corium should be first filled with the solution. This is accomplished by using a very fine needle and introducing it almost parallel to the surface of the skin. A few drops are injected, causing a slight wheal to appear, and after a pause of a few seconds the needle is pushed farther, and the process is repeated until the whole of the corium is infiltrated. The subcutaneous and deeper tissues are to be treated in a

similar way. J. Jackson Clarke (*Lancet*, Jan. 18, '96).

SPINAL SUBARACHNOID INJECTIONS.

—This method of producing anæsthesia was first resorted to by J. Leonard Corning, of New York. It consists in the injection of a solution of cocaine into the subarachnoid cavity. This soon acts upon the spinal centres and ganglia, and the whole or lower half of the body becomes analgesic.

The needle should be of gold or platinum, from three inches and a half to four inches in length, and the bevel of the point should be short. It should be provided with a small steel nut, sliding freely upon the needle and fixable at any point of its length by a set-screw. When the needle is finally within the spinal canal, this nut is pressed against the skin and fixed in place so as to prevent any further entrance of the needle. The needle is left *in situ* until anæsthesia supervenes, and is then withdrawn. The most rigid asepsis is enjoined. It is preferable to puncture between the second and third lumbar vertebræ, as this causes the anæsthetic to arrive at the cord more quickly, and in a more concentrated condition than when introduced lower down. Corning notes that there has been a singular immunity from fatality until now—but this will not go on indefinitely, and there should be a concerted effort by the invocation of every known precaution to keep the mortality as low as possible.

While, as stated, the point of introduction is a space between the fourth and fifth lumbar vertebræ, one-half inch from the median line, the patient occupying a sitting position, in some cases of spinal deformity it has been impossible to insert the needle at this point. Injections have been made between the sixth and seventh cervical vertebræ. The

fluid should never be injected except when the cerebro-spinal fluid is flowing from the needle, and it should always be injected slowly, requiring from forty to sixty seconds.

The symptoms as described by Murphy (Jour. Amer. Med. Assoc., Feb. 9, 1901) are as follow: First there is a sensation of heat passing over the entire body, then that of thirst, followed in a few minutes by nausea, which may last for ten minutes. Preceding the vomiting there is increased rapidity of pulse, pallor, and respiration. These symptoms last for a few minutes usually, but are in some cases very marked and make stimulation necessary. Murphy thinks that hyoscine hydrobromate, $\frac{1}{200}$ grain, and nitroglycerin, $\frac{1}{100}$ grain, are the best stimulants under the circumstances. The analgesia usually appears in from 3 to 10 minutes, though sometimes it may be delayed from 20 to 30. It usually begins in the feet and gradually ascends, though in rare instances it may first appear as a band around the body and then descend. And in rarer instances still it has been known to ascend from the level of the injection and involve the upper extremities, the neck, and face.

The post-operative symptoms are: Headache, lasting several hours to several days; more or less prolonged vomiting; vertigo and some ataxia in gait, which may persist for some days; rise of temperature. Coma and delirium have been observed. Mental exaltation frequently so. Failure to obtain analgesia after the employment of this method is ascribed by Murphy to faulty technique or personal idiosyncrasy. Alcoholism exposes the patient to be unfavorably affected.

Bier, of Kiel (*Deutsche Zeitschrift für Chirurgie*, Apr., '99), first anæsthetizes the region for the puncture by

Schleich's plan of infiltration. He then injects within the meningeal cavity a few drops of a dilute solution of cocaine, introducing from $\frac{1}{10}$ to $\frac{1}{6}$ grain.

Four cases in which the method was used for major operations. A slightly larger quantity of cocaine was used than recommended by Bier ($\frac{1}{6}$ grain of cocaine), but the effects produced were practically the same, complete anæsthesia following in every case and lasting sufficiently long for the completion of the operations, the longest of which lasted fifty minutes. The operations performed were a Pirogoff amputation of the foot for carcinoma; amputation of the leg and extirpation of the inguinal glands for melanosarcoma of the calcaneum; removal of an extensive skin carcinoma in the region of the knee and enlarged inguinal glands; and resection of the knee for tuberculosis. Sensation returned a short time after the completion of the operation, and there were no serious after-effects in any case. Seldowitsch (*Centralb. f. Chir.*, vol. xxvi, p. 1110, '99).

The technique of the lumbar puncture is not as simple as might be supposed. In stout individuals the spinous processes are difficult of palpation, and even in cases where there are not considerable fat a patient that was very nervous when placed in a direct posture would throw the muscles into such rigidity as to render it almost impossible to fix the point of the spinal process. Unless the lumen of the needle had become occluded in its passage through the soft parts, cerebro-spinal fluid flows without any difficulty. In some cases aspiration either with the syringe that is being employed or a special suction will still more facilitate the outflow of the cerebro-spinal fluid. It is well to allow a full minute for the injection, thus giving ample time for the solution to thoroughly mix with the cerebro-spinal fluid. The solution should be freshly prepared with a menstruum of sterilized water and boiled for a full minute before using. It is believed that a concentrated solution of a definite quantity will not produce disagreeable symptoms

any more than the same dose in a diluted solution, and that the effect will last longer. Analgesia is present in the soles of the feet from 1 to 5 minutes, and in from 5 to 15 minutes extends to the umbilicus. In no personal case did it fail to reach the umbilicus when the solution proved at all effective; in 2 cases it reached to the vertex. In none of the cases did the analgesia subside below the umbilicus under 27 minutes. The amount of cerebro-spinal fluid present in each case has probably direct bearing upon the extent of the analgesia. With a reliable solution it is believed that a failure to produce analgesia depends upon the failure to introduce the solution into the spinal cord. In the greater number of cases disagreeable features were present, among them being vertigo, nausea, vomiting, headache, chills, elevation of temperature and increased pulse-rate, pallor, cold sweat, and involuntary urination and defecation. The case of Tuffier, in which death occurred, was found, upon a post-mortem examination, to have been affected with cardiac and pulmonary lesions. In some personal cases there were even heart-murmurs present, and in one case there was gangrene of the lungs, but no harm supervened. Insensibility to the surgical procedure is not all that should be required of an ideal anæsthetic, and, on the other hand, such features as the knowledge by the patient of what is taking place around him and the perception of the gravity of the operation are to be distinctly avoided. A further trial and conscientious study of a large collection of cases is still required to ascertain the danger that may accompany employment of this form of anæsthesia. G. R. Fowler (Phila. Med. Jour., from Med. News, Jan. 5, 1901).

In obstetrical and gynaecological cases the following technical points are important: 1. Surgical cleanliness in all things and a fresh, aseptic solution of cocaine, full strength. The method of sterilization used at the present time is to raise the temperature of the solution (in small bottles) to 80° C. for one hour on two successive days. 2. The needle

need not be longer than 7 centimetres and should be kept sharpened. 3. A nurse should stand at patient's head when the puncture is made to keep the back arched forward. A case was recently reported in this city of a patient suddenly sitting upright and breaking the needle. 4. During an operation the patient's ears should be kept closed with cotton and the eyes covered with a towel or cloth.

The results, as far as they go, would tend to support the view that spinal anæsthesia is not very dangerous, except perhaps to the child *in utero*. When it produces disagreeable symptoms, they are usually transient. In the labor cases it usually retarded progress. Finally, the anæsthesia it produces is for a fairly definite period of time without affecting consciousness and with full control of the voluntary muscles.

From a study of these cases the use of the lumbar puncture in multiparæ would seem to be less called for than inhalations of chloroform. The results obtained from its use in primiparæ were also not very encouraging, but when good results can be obtained in a few cases the experiments should be continued.

In instrumental deliveries, when urgency is required and the patient is not of a very nervous temperament, the spinal narcosis seems to meet every indication. The delivery would be much facilitated by the patient's aid, which is not obtained under general narcosis, and the dangers of retained placenta and post-partum hæmorrhages are lessened.

It is doubtful if the puncture will ever replace general narcosis in abdominal operations. In vaginal cœliotomy and minor gynaecological work it seems to have its greatest field of usefulness, and will, it is believed, come more in vogue as its merits are more fully observed and understood. N. J. Hawley and F. J. Taussig (Med. Record, Jan. 19, 1901).

It is contra-indicated in children and in nervous and timid patients, particularly women; also in operations demanding muscular relaxation, such as those for the reduction of fracture and

dislocation, and in cases of difficult and prolonged laparotomy. In women, particularly those who are young and nervous, lumbar anæsthesia is not satisfactory, as it is so liable in such subjects to give rise to intense discomfort and a very rapid pulse, and to be followed by obstinate vomiting and severe and prolonged headache. It should only be used in female patients who are calm and free from timidity, and in cases in which general anæsthesia is contra-indicated. Chaput (Bull. et Mém. de la Soc. de Chir. de Paris, Apr. 30, 1901).

Conclusions based on fifty cases of spinal analgesia: 1. Cocaine is far more satisfactory than eucaine. The latter is less potent, more evanescent, the areas of analgesia are frequently "patchy," having the pain-sense retained all around them and not being so complete below definite levels. The cocaine produces no more unpleasant after-effects than eucaine, and is decidedly more reliable. 2. Analgesia to the level of the diaphragm can be depended upon in all cases where a moderate dose of a potent solution of cocaine has been introduced by lumbar puncture. In some the analgesia is sufficient for operation on the upper extremities. 3. Complete analgesia—including the eyes, mouth, and throat—has occurred. It does not entail more severe after-effects than when the lower extremities only are involved. 4. The preparation of the patient as for a general anæsthetic diminishes all the unpleasant effects of cocaine and eucaine and often prevents them altogether. 5. By moderate doses of bromides before the injection the initial vomiting is frequently avoided and the liability of headache lessened. 6. In neurotic patients there are often hysterical symptoms directly following the completion of the injection, but, as a rule, in a few moments a calm follows and the patient lies perfectly still. 7. Initial nausea and vomiting often occur soon after the puncture, but last only for a moment or two, and usually do not recur during the operation. As consciousness, as well as the muscular power, is preserved, the danger of the introduction of the vomitus into the lungs is practically *nil*. 8.

Analgesia lasts from 30 minutes to 4 hours. 9. Depression after the puncture is inconsiderable. The use of ethyl-chloride (Bengue) largely prevents pain when the needle is introduced. 10. The preparation of the patient, the use of nitroglycerin by hypodermic injection, or the employment of coal-tar products with caffeine, control the headache, which is in many instances an after-effect of spinal puncture. 11. In a few cases there may be motor paraplegia or vertigo. Both are temporary. 12. Spinal puncture has not affected normal or diseased kidneys. 13. Usually the tactile power, muscular sense, and the ability to detect heat and cold are retained. The cautery at a dull-red heat causes no pain, while hot water produces marked discomfort. 14. Usually the patient sleeps the first night. 15. There is often a temperature of a few degrees within eight or ten hours of the operation. Whether this is the direct result of the puncture or the effect of psychical disturbances is not determined. The circulation and respiration are not seriously embarrassed. W. S. Bainbridge (Med. News, May 4, 1901).

Series of 406 cases operated on under this method of anæsthesia without a death. A solution of from 1 to 2 centigrammes ($\frac{1}{10}$ to $\frac{1}{8}$ grain) of cocaine, made up with cerebro-spinal fluid which had previously been withdrawn by puncture, was used in all the cases. Although there have been no fatal cases, the author has observed nearly all the unpleasant sequelæ, such as headache, etc. The method has proved satisfactory, but should not be used in the presence of contra-indications. Sequen in his last series of cases reports 2 deaths. In 1 there was an incarcerated hernia with the phenomena of septicæmia, while in the other arteriosclerosis was present.

In the discussion which followed Jonnesco stated that he used the method in only 8 cases, and in 1 of these with a fatal result; no arteriosclerosis nor organic lesions were present, and death was attributed directly to the cocaine. The author has abandoned this method, for the reason that its mortality is higher than ether or chloroform, and

the after-effects, as a rule, are severe. Racoviceano-Pitesci (Bull. et Mém. de la Soc. de Chir. de Bucarest, Dec., 1901).

The injection of sterilized water into the arachnoid sac accomplishes the same anæsthesia, but is apt to cause the same accident as the subarachnoid injection of cocaine in the treatment of sciatica. For subarachnoid use, aqueous solutions of cocaine should not be diluted with water; after the injection, patients must be kept in bed for from two to three days. M. Guinard (Jour. des Praticiens, March 22, 1902).

Corning emphasizes the following precautions: The puncture must not be made in the operating-room. The needle must be very thin, the solution one of 2-per-cent. of cocaine hydrochlorate. The patient should sit up, and the puncture should then be made on the level of the crests of the ilium. The injection should be made very slowly, taking a minute for injecting 15 minims of the liquid. The most common disadvantages of this method are vomiting during operation and headache afterward. Six cases, out of 2000 operations, died after lumbar puncture, 3 of them with tuberculous meningitis.

In 314 times, alarming symptoms occurred in but 1 case. The ages of the patients varied from 8 to 86 years, and many of them suffered from well advanced organic disease. Remote complications from the use of the drug were not observed. A. W. Morton (Amer. Med., Aug. 3, 1901).

Cocainization of the spinal cord has been carried out on 62 occasions in the clinic of von Mikulicz. In 40 cases the analgesia was complete, in 9 it was incomplete, and in 12 there was none at all. The injections were frequently followed immediately by such symptoms as sickness, vomiting, profuse sweating, a feeling of general oppression, and tremors all over the body. Twice there was genuine collapse. Among the untoward after-effects were continuous vomiting, pains in the loins and back,

and severe headache. On several occasions there was retention of urine. The unreliability of the method and the occurrence of these unpleasant symptoms have led to the abandonment of the injection of cocaine into the spinal canal at von Mikulicz's clinic. (Beiträge z. klin. Chir., Bd. xxxv, H. 2, 1903.)

Topical Administration.—Cocaine is applied locally to the mucous membranes and the skin for the relief of pain, to induce local anæsthesia for operative purposes, to control hæmorrhage, and for diagnostic purposes. When applied locally to a mucous membrane, cocaine causes a temporary blanching and shrinkage, with an anæsthetic condition of the part. The former are due to a constriction of the blood-vessels, the latter to a paralysis of the peripheral filaments of the sensory nerves. The anæmia produced is only temporary, and is followed by a marked congestion. For therapeutic study we will observe the application of the remedy on the various organs, noting at the same time the strength of the solutions generally used in each case.

If a 40-per-cent. freshly prepared solution of cocaine is applied from one to one and a half hours to the unbroken skin, there results a local anæsthesia. Circumcision accomplished without pain by the simple external application of a 40-per-cent. solution of cocaine. Before the operation the parts were carefully cleansed of all sebaceous and oily matter, and well dried after the thorough use of an antiseptic. Then a solution of cocaine was applied to the line of incision by means of a pledget of absorbent cotton. The saturated cotton was kept in contact with the parts for twenty minutes, when it was removed and the part allowed to dry for ten minutes. The cocaine was then reapplied, and this was continued for from one to one and a half hours. The skin may be quite as effectually anæsthetized by this method as by hypodermic injections of cocaine, it only being necessary

to keep the solution sufficiently long in contact with the parts. After such an application of cocaine numbness will persist in the skin for from four to five hours. W. P. Beach (Brooklyn Med. Jour., July, 1901).

Cocaine should not be given for over-coming pain in the eye, because its effect is only temporary. The patients drop it in the eye too often, and corneal injuries result. For operation or with conjunctival injection the author uses cocaine, with suprarenal extract, and morphine hypodermically. Schleich's infiltration anæsthesia is not recommended for operations on the eyelid. Cocaine is useful for photophobia and mydriasis. In place of cocaine for controlling the pain, warm or cold compresses, leeches, or dionin are ordered. Fuchs (Wiener klin. Wochen., Sept. 18, 1902).

EYE.—For use as an anæsthetic in the eye cocaine in solution of from 1 per cent. to 4 per cent. in strength may be employed, 1 to 5 or more drops being instilled. All operations of a painful character, the pain of an acute inflammation, or that caused by the presence of a foreign body are indications for cocaine. Its use in keratitis is not advised in that it has produced permanent opacities in the cornea.

NOSE, PHARYNX, AND LARYNX.—The application of cocaine (5 per cent. to 20 per cent.) in the mucous membrane of these parts is useful not only for therapeutic purposes and operations, but also for purposes of examination and diagnosis.

Before scarifications, etc., cocaine may be applied in a powder; cocaine hydrochloride, magnesium carbonate, $2\frac{1}{2}$ drachms. A moist compress is laid outside, for ten minutes, which the patient is instructed to press lightly against the part. If the skin is intact, pure basic cocaine must be used instead. Unna (Jour. Amer. Med. Assoc., Apr. 30, '98).

The following solution of cocaine is stable:—

R Cocaine hydrochlorate, 4 grains.

Distilled water, $2\frac{1}{2}$ drachms.

Salicylic acid, $\frac{1}{8}$ grain.

Editorial (Jour. de Méd. de Paris; Phila. Med. Jour., May 26, 1900).

The natural sensitiveness of the parts is obtunded by the anæsthesia induced; the shrinkage of the soft parts induced by the contraction of the blood-vessels makes more prominent the distinction between hypertrophy of the soft tissues and tumors of cartilaginous or bony character; again, by temporarily controlling the hæmorrhage (by contraction of the blood-vessels) and the shrinkage of the soft parts, the field of operation is made more clear and open. Nasal and laryngeal polypi are more easily diagnosed and removed, and operations on the uvula, tonsils, epiglottis, and larynx are facilitated. The Eustachian catheter is more easily introduced after the application of a solution of cocaine to the nasal cavities and the naso-pharynx. In acute coryza or rhinitis the insufflation every two hours of a small portion of a powder consisting of cocaine muriate, 1 part; bismuth subcarbonate, 5 parts; and talc, 15 parts, is useful. Another formula for the same uses consists of cocaine and morphine, 1 part of each; bismuth, 5 parts; used as snuff like the preceding.

Cocaine carbolate has been recommended in nasal catarrh and ozæna, either pure or 5- to 10-per-cent. solutions in alcohol or spirit of ether, or 1-per-cent. solution in diluted alcohol containing 70 per cent. of water on cotton or by instillation, or 5- to 10-per-cent. triturations with acetanilid or boric acid for insufflation.

Cocaine solution is also used to anæsthetize ulcers or hypertrophies previous to the application of acids or instruments. Liquid applications may be made by means of cotton pledgets dipped

in the cocaine solution by the spray of an atomizer; in powder by insufflation as above.

GENITO-URINARY TRACT.—The injection of a few drops of a 2-per-cent. solution of cocaine renders catheterization easy and painless, provided there is no stricture. Operations on the bladder (lithotripsy, litholapaxy, catheterization of ureters, etc.) are rendered painless through previous injections of cocaine. Weak solutions (not strong, the 2 per cent.) must be used, as fatal poisoning has followed the injection of 5 drachms of a 5-per-cent. solution into the urethra.

Wittsack, of Frankfort, advises the use of lactate of cocaine in the treatment of tubercular cystitis. He instills a solution containing 15 grains of cocaine lactate and 75 minims each of lactic acid and sterilized distilled water, previously emptying the bladder, but not washing it out.

GYNÆCOLOGY.—For application to the mucous surfaces of the vulva, vagina, and the uterine cavity, stronger solutions (10 per cent. to 20 per cent.) are used. Here, as elsewhere, the use of cocaine anæsthesia should be confined to minor operations (curettage, dilatation of cervix, removal of uterine polyps, etc.). In operations extending below the surface parenchymatous injections should supplement the applications to the mucous surface.

RECTUM.—The anæsthetic solution (5 per cent.) is here applied to the mucous membrane by means of pledgets of absorbent cotton saturated with the solution. Parenchymatous injections may also be needed. In major operations or in complicated ones, general anæsthesia is advised.

SKIN.—The topical application of cocaine has been suggested for the cure of cracked and fissured nipples, but is

not advisable, as through its use lactation may be interfered with. This latter suggests the use of a 5-per-cent. solution of cocaine made with equal parts of glycerin and water as a solvent to inhibit lactation or cause its complete cessation. The glands are bathed four or five times daily with the solution and supported by means of a bandage.

In zona cocaine not only relieves the pains, but also causes a regression of the eruption, bringing about its disappearance in the course of a few days. Twenty-three cases thus cured. The affected surface is painted with equal parts of wool-fat and petrolatum rubbed up together with 1 per cent. of cocaine hydrochlorate, and dressed with linen spread with the same ointment. Bleuler (*Nouveaux Remèdes*, No. 1, 1900).

Incidentally it may be noted that Geley, of Bordeaux, has found that cocaine has an antipyretic action when applied to the skin, provided the applications be made at a time when the temperature is no longer rising. This action is analogous to that of guaiacol, though less marked.

Cocaine introduced by cataphoresis. Solution recommended consists of cocaine (the alkaloid, not the hydrochlorate), 6 grains, dissolved in a drachm of guaiacol. If a little of this mixture upon a piece of blotting-paper is placed on the skin, and a current applied through it, the cocaine quickly penetrates, and local anæsthesia can be produced in about four or five minutes. The positive electrode should be placed on the blotting-paper. It should consist of a flat disk of bare metal of suitable size. A platinum surface is the best, but tin or any other metal which does not easily become corroded will do almost as well. Care must be taken that the metal itself does not touch the skin at any point. The current is then turned on until it reaches about 4 milliampères for an electrode half an inch in diameter. At first from 10 to 15 cells are necessary to produce this current, for the solution has a high

resistance; but soon conduction improves, and the number of cells may be reduced. H. Lewis Jones (Clinical Jour., Mar. 8, '99).

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COCAINOMANIA, OR COCAINE HABIT.

Definition.—Cocainomania is an irresistible craze, crave, or impulse to intoxication by cocaine, or any of its salts or combinations, at all risks. Unless a cure of the "habit," or, more accurately, the disease of cocainomania be effected, the cocaine *habitué* cannot refrain from resorting to the employment of the drug, if a supply can possibly be procured, whenever the craze, crave, or impulse seizes upon him.

Varieties.—The two leading types of the cocaine habit are (1) *periodical*; (2) *continuous*. In the former the *habitué* will, after an outbreak of cocaine intoxication, go on without cocaine in any form for a longer or shorter interval, till a condition of mental unrest, arising sometimes apparently from within, ushers in a period of more or less complete temporary abandonment to the drug. Sometimes the outburst is inaugurated by a recurrence of the acute pain, or the asthma, or other physical trouble, for the assuagement of which the poison was originally taken. In some highly-strung women the menses act as the exciting provocative, particularly when accompanied by acute dysmenorrhœa. In the latter variety, the continuous, the unfortunate victim keeps on steadily taking the drug daily in rapidly-increasing quantities till he or she is rendered incapable of exertion, sometimes of connected thought, by advancing paralysis or by insanity. In some instances the indulgence is *social*, in others *solitary*, the latter being the

rule and the former the exception. Some variation is observable when cocaine addiction is associated with alcoholic or other narcotic indulgence. In this way the addiction may be double, triple, or fourfold: twofold, as alcohol or morphine with cocaine; threefold, as with alcohol and chloral; fourfold, as with alcohol, morphine, and chloral.

Symptoms.—On taking a fresh dose, in chronic cocainomania, there are, generally within ten minutes, exuberance of spirits, quickened pulse, general acceleration of the circulation, talkativeness, restlessness, hallucinations, with rapid and somewhat spasmodic breathing, intense joyous activity, and a remarkable overconfidence in one's capacities and strength. Even when actually weaker, during the cocaine-delirious intoxication, the taker feels infinitely stronger and more agile. Occasionally there is vertigo, with some confusion of the intellectual faculties. There is usually great cerebral excitement, with dilated pupils, throat dryness, and headache, the last named frequently not severe enough to be painful. There is a rise of temperature, with a loss of the sense of time, though memory is usually intact. Depression and prostration follow very often. When the dose has been relatively moderate,—*i.e.*, not larger than the cocaine-taker has been gradually accustomed to take,—the period of nervous hyperexcitation has passed away by from half an hour to two hours. When the dose taken has been relatively immoderate, the depression and nervous debility may remain for days or till the next dose.

In chronic cocaine poisoning, though some habitual cocainists do not appear to show any symptoms of injured health or vigor, others appear wasted, with pale-yellowish skin, the extremities clammy,

with cold perspiration. The eyes are glistening and sunken with dark, sub-ocular rings, the pupils being dilated. Anorexia and impaired digestion are present, with palpitation, dyspnoea, tinnitus aurium, tremors, neurasthenia, and uncertainty of step. Hallucinations, especially of sight and hearing; mistrust; delusions of persecution; and general paralysis sometimes end the scene. Yet, in some cases, one sees occasional spells of brightness, brilliance, and mental activity.

[The effects of chronic cocaine intoxication are as follows: Physically there is the rapidly-developing marasmus so characteristic of chronic cocaine intoxication. Psychically we find feelings of apprehension; delusions, chiefly of persecution; and hallucinations, visual or sensory. Frightful forms appear everywhere, or small living things creep upon the skin. Insomnia, loss of appetite, and impotence complete the picture of cocaineism. OBERSTEINER, *Corr. Ed., Annual.*]

Three cases of chronic cocaineism in which the predominant symptoms were those relating to general sensibility, consisting chiefly of hallucinations producing a sensation as if foreign bodies were under the skin. The first, a merchant aged 48, was continually scraping his tongue, imagining that it was filled with small, black worms, and picking the skin to find choleraic microbes. The second, a pharmacist, attempted to extract microbes from his skin with his nails and with a needle. The third, a physician, sought for crystals of cocaine under the skin. Hallucinations of cutaneous sensibility are first to develop; hallucinations of vision, hearing, taste, and smell occur later. Disturbances of ideation, as delirium, are consecutive to the hallucinations. The latter are less active than those produced by alcohol or absinthe. Epileptiform attacks occurred with two of the patients and cramps in the third. Toxic epilepsies, when there is no predisposition, disappear with the cause. Magnan and Saury

(*La Tribune Médicale*, Feb. 3, Mar. 28, '89).

Aphrodisiac effects of cocaine shown in the case of a woman, married and highly respectable, who became a victim of cocaine, and who, while under its influence, would invariably utter expressions and do things which she would not even have thought of when in her normal condition. These effects appear to be more pronounced in females than in males, and hence the inadvisability of the indiscriminate use of cocaine. M. K. Bowers (*Med. Age*, Dec. 26, '91).

Case of chronic cocaineism, in which the patient suffered from hallucinations, under the influence of which, according to his statement, he twice committed assaults. Regarded as a case of cocaine epilepsy, on account of the suddenness of his attacks of *furor* and a certain amount of amnesia. He formed the habit by using it for a nasal trouble. Lewin (*Deutsche med.-Zeit.*, Jan. 1, '91).

Magnan's sign—an hallucination of cutaneous sensibility, characterized by a sensation of foreign bodies under the skin, which are described as inert and spherical, varying in size from a grain to a nut, or as living organisms, worms, bugs, etc.—observed in two cases. Ribakoff (*Gaz. degli Ospedali e delle Clin.*, Aug. 4, '96).

The first feeling a cocaineist has is an indescribable excitement to do something great, to leave a mark. But this disappears as rapidly as it came. The second sensation—at first, at least, no hallucination—is that his hearing is enormously increased. Very soon every sound begins to be a remark about himself, mostly of an offensive kind, and he begins to carry on a solitary life, his only companion being his syringe. Every passer-by seems to talk about him. After a relatively short time, he begins the "hunting of the cocaine bug," and imagines that, in his skin, worms or similar things are moving along.

Personal opinion that there is a question of disturbance in the frontal cortex, originating, perhaps, in skin dysæsthesiæ, and not a simple visual hallucination or retinal projection. Springthorpe (*Quarterly Jour. of Inebriety*, Jan., '97).

In *acute* cocaine poisoning there may, or may not, be the exhilaration stage, the poisoned sometimes falling rapidly into collapse and insensibility after exceedingly transient symptoms of paleness, faintness, fullness of head and giddiness, skin creepings, profuse perspiration, præcordial distress, rapid hard or weak pulse, loquacity, restlessness, agitation, and hysterical excitement. The pupils are dilated and dull, the perspiration, at first quickened, becomes spasmodic and labored, unconsciousness sets in, convulsive seizures appear after muscular cramps, sometimes with tetanic spasms, followed, it may be, by deepening cyanosis, violent delirium, enuresis, and paralysis of the sphincters. Withal there are often localized areas of anæsthesia. In non-fatal cases, though the acute symptoms may pass off in a couple of hours or so, feelings of languor, malaise, and local pains may linger for days.

Differential Diagnosis.—Though, in many cases, unless the presence of cocaine can be determined by finding the drug or by the brown stain over the seats of hypodermic injection, this particular “habit” or mania cannot be diagnosed from other forms of narcotic addiction, there are one or two prominent symptoms which point to cocaine as the special mania. Especially in the earlier stages, though to a larger extent in the more advanced, alcohol is excluded by the absence of symptoms pointing to organic functional bodily lesion. The cocaineomaniac not only often shows no symptom of bodily or mental disturbance, but manifests simply a sense of satisfaction, and an appearance of increased capacity for intellectual and muscular work. In many cases the closest physical examination has failed to reveal anything abnormal. Indeed, at

times the only symptom discernible has been an apparently improved condition. In some instances only the closest continuous scrutiny of a business partner or a wife has, after a time, disclosed even the slight falling off in the character of the work and of the judgment, the actual amount of work having been occasionally increased. One point of differentiation, even from etheromania (which is more speedy in the appearance, progress, and cessation of toxic symptoms than either alcohol, opium, morphine, chloral, or chloroform), is the greater quickness with which the characteristic phenomena of cocaine poisoning set in and pass away. Still another discriminating symptom is the extraordinary self-confidence and elation arising from cocaine. In etheromania the odor of the breath is characteristic, and the activity more effervescent and demonstrative. A point of distinction from alcoholomania is that, while this is mostly social and less often solitary, cocaineomania is almost always solitary. Yet another difference from alcohol and morphine is that the prevailing delusions of cocaineomania are delusions of persecution. These rarely occur with alcohol, except temporarily sometimes in delirium tremens or in chronic alcoholism, and still less often with morphinomania. They are frequently seen, however, with the chronic cocaine habit, and are at once more marked and more persistent with cocaine.

ALCOHOLISM.—The subject of this disorder shows greater evidence of morbid change; the subjective and objective symptoms are more marked. There is distinct attraction for social pleasures, whereas the narcomaniac prefers solitude.

MORPHINOMANIA.—Characteristic symptoms set in and disappear more

quickly. Cocainomania is characterized by marked self-confidence and elation.

ETHEROMANIA.—The odor of the breath is characteristic and the activity more effervescent and demonstrative.

Etiology.—The chief predisposing influence is, undoubtedly, the neurotic diathesis. On the nervo-sanguine and passionate temperaments cocaine has a special excitant power. Once taken in any form for the assuaging of acute pain, on such temperaments this drug fastens as if with a grip of iron imbedded in velvet. In one case of a life-abstainer from alcohol, cocaine, taken once during a prostrating attack of agonizing pain, exercised so powerful a hold that only after a strenuous struggle of over a week's duration could the veteran nephelist overcome the imperious impulse to take a second dose. He felt that, if he yielded, his will would have been rendered powerless for the future against the tremendous fascination of the drug which has banished his pain as if by magic, and of the name and other properties of which he was utterly ignorant. In "neurotics" I have seen a few doses, taken medicinally, set up the "cocaine habit." In transmitted gout, with irritable and susceptible brain and nervous system, this special predisposition has been markedly present. It has also been noted in syphilis and scrofula with cerebral complication. Epileptic neuroses have been greatly in evidence.

EXCITING INFLUENCES.—Over and above the psychological excitation of the drug itself, the exciting causes seen by me have practically been confined to urgent clamor for relief from physical agony, such as occurs at times in asthma or neuralgia.

Cocaine, which has but recently been introduced in India, is generally taken in the form of powder sprinkled on a

paste of slaked lime, which is buttered on a betel-leaf. The mass is rolled up and chewed for about fifteen minutes. The first symptom of the so-called hilarity is a heaviness of the head. Then quickly follow a wild throbbing of the arteries of the neck and palpitation of the heart. The pulse never exceeds 110. The inebriate wishes to be left alone; he will not speak lest saliva escape from the mouth. The ears become hot, the cheeks pale, the nose pinched and cold. The height of intoxication is marked by coldness of the finger-tips and dilatation of the pupils. This stage lasts from thirty to forty-five minutes, when the victim longs for a fresh dose.

The teeth and tongue of old *habitués* turn absolutely black. The craving for an increased dose is pronounced. In one case it was so marked as to cause a jump from 1 to 20 grains in a month. The worst sequelæ are very obstinate forms of diarrhoea and dyspepsia. Of the mental derangements, hallucinations, and delusions causing dejection and fear, are common. A more miserable object than a confirmed Hindoo cocaine-eater cannot be pictured. The drug is altogether more disastrous in its effects than is opium or any other narcotic used in India. To quote the words of a victim, "To eat cocaine is to court misery." Kailas Chunder Bose (Brit. Med. Jour., April 26, 1902).

I have not seen insomnia incite to cocainomania as it frequently does to morphinomania. Physical pain has been the initial starting-point. The use, for any purpose, of cocaine is an unmistakable influence inciting to the "cocaine habit" in constitutions predisposed to narcotic excitation. Other narcotic substances also both predispose and excite to the cocaine mania. Morphine, for example, long continued is apt to create a crave or impulse too imperious to be satisfied with morphine narcotism alone.

Case of mixed addiction, morphine and cocaine, the habit for the latter drug having been acquired by its use as a

substitute for the former, with the usual disastrous results, namely: loss of appetite and sleep, vertigo, syncopal and epileptiform attacks, and, finally, hallucinations and delusions, ideas of suspicion, jealousy, and persecution; also hallucinations of animalcules on the skin, which are so characteristic of the action of cocaine. Cocaine is a toxic agent far more formidable than morphine on account of the rapidity and intensity with which the sensory, motor, and intellectual derangements develop under its use. Warning against employing it as a substitute for morphine with those addicted to the latter drug. Laury (*La Sem. Méd.*, Aug. 10, '90).

In morphinomaniacs cocaine is sometimes resorted to simply with the object of heightening the pleasurable sensations of intoxication. In not a few instances cocaine addiction has been rapidly set up in the vain attempt to cure alcoholomania or morphinomania by substituting cocaine. This attempt at the cure of the original form of narcomania (a mania for narcotism by any narcotic) is sometimes openly attempted with the best intentions; but is more often unknowingly tried simply because cocaine has been a component of the so-called "cure," though not disclosed by the manufacturers. In this way even some abstainers from alcoholic liquors who pride themselves on their consistent temperance have insensibly become cocaine slaves, they having had no idea that they and theirs were partaking of a narcotic poison more fascinating and perilous than the object of their aversion: alcoholic intoxicants. A striking object-lesson of medical unwisdom was the appearance of a crop of cocainomaniacs in England shortly after the announcement, in a British medical annual, of the reputed cure of alcoholomania and morphinomania by means of cocaine, in another country.

Below sixteen years of age there would

appear to be a lessened susceptibility as the years go down, children showing less cocainomaniacal proclivities than adults, and not responding so readily to the narcotic properties of the drug in doses relatively corresponding to their years. Though the young are readily intoxicated by cocaine, they are not so prone to become subject to the mania for intoxication by cocaine.

As to sex, the majority of the cases have been male; but this has not arisen because of a lesser susceptibility that is found in man, but probably is owed to occupation exercising a stronger influence.

Occupation is a predominant factor, most of the victims having been medical men (I have seen a number of cases in members of the legal profession), literary men and women, and the cultured generally.

Climate exercises considerable influence, which may account for the greater prevalence of cocainomania in the United States of America and northern France, as compared to Great Britain. Racial characteristics and atmospheric conditions modify purely climatic environment, however; witness the practical absence of cocainomania among the great community of the Jews, and the rapid electrical disturbances, as well as the tremendous temperature alterations, of North America.

The cocaine inheritance has not had time to show itself, if it exist; but the "cocaine habit" as an outcome of transformed narcomaniac transmission I have seen in several families.

Pathology.—**ACUTE COCAINISM.**—Though a large number of cases of acute cocaine poisoning have been recorded by Germain Sée, Mattison, Schede, and others, comparatively few have proved fatal. Probably the fatalities have run

not much over 10 per cent. Even in exceedingly grave cases, when the sufferer appears almost moribund, the distress and collapse often suddenly and unexpectedly give way and the apparently dying patient makes a good recovery. Hence there has been little opportunity for post-mortem inspection. Clifford Allbutt says that the heart is found in diastole and the nervous centres are congested. According to Ehrlich, vacuolar degeneration is found in the hepatic cells, the latter being greatly enlarged and the nuclei atrophied. The convulsive respiratory paralysis is ascribed by Mosso to tetanus of the respiratory muscles, and the great rapidity of the circulation to paralysis of the vagus. The peripheral blood-vessels are contracted. Cocaine is stated to alter and injure the leucocytes; Maurel and Beaumont Small state that these become spherical and rigid, with increase of size. They seem also to have a tendency to locate next to the vessel-wall.

Death may supervene at an early stage from syncope, or at a later from asphyxia. Cocaine acts on the central nervous system, first exciting and afterward paralyzing this. Doubts have been expressed as to whether the anæsthesia produced by cocaine is due to the vasomotor disturbance or whether the drug directly paralyzed the nerve-terminations. Brown-Séquard believes the latter, holding that cocaine acts through the peripheral nerves on the nerve-centres, which reacts in inhibiting sensibility. I am inclined to think that the central nerve-centres are affected in both ways: by vasomotor paralysis and by peripheral excitation.

CHRONIC COCAINISM, INCLUDING THE MANIA FOR COCAINE.—A distinction ought to be made between the physical poisoning by the drug (cocainism), and

the overpowering mania for the drug (cocainomania, or the "cocaine habit"). Of the pathology of the latter little can be said specifically. Usually scavenger or spider-cells are found in the brain; but as most cocaine *habitués* have previously been indulgers in alcohol, no reliance can as yet be placed on these appearances as pathognomonic of cocaine mania. Marasmus, with absence of fat, is usually the most prominent after-death appearance, and there has not been noted the darkish hue of the stomach's interior which has been seen in some cases of fatal opiomania. The post-mortem appearances include dark and fluid blood, with congestion of lungs and other organs, but these are not peculiar to cocaine poisoning. There have not been observed traces of cocaine tissue-degradation, and organic degradation which are so often met with in the stomach, liver, kidneys, and other vital organs of alcoholic cases, unless when chronic alcohol poisoning has preceded or accompanied the cocaine indulgence. When cocaine is contemporaneous with chronic morphine poisoning the wasting is even more marked. Though the minimum fatal dose in acute cocaine poisoning is not quite fixed, death has been recorded as the result of less than half a grain, and several deaths have occurred after 8 to 12 grains; yet the *habitué* can set up such a tolerance of the drug as to raise the daily consumption to some 30 or 40 grains. In some instances the daily average has been more than double this. In one case 80 grains a day were subcutaneously injected, besides 60 grains of morphine. One death occurred in 20 minutes, 1 in 4 minutes, and a third in 40 seconds (Hamilton and Godwin).

Prognosis.—The prognosis of *acute* cocaine poisoning is, on the whole, favor-

able. Even though death almost always seems impending from the gravity of the symptoms, the great majority of cases recover if judiciously treated soon after the poisonous dose has been taken. Generally, after three-fourths of an hour have passed, the prognosis is even more favorable. This cannot so unreservedly be said of *chronic* cocaine poisoning (the cocaine habit, or cocainomania), of which the outlook is, under ordinary conditions, unfavorable. If, however, the patient surrender his liberty and place himself absolutely under control in a special home or in a hospital for a sufficiently long period, the prognosis may fairly be considered to be more favorable. The prognosis of cocainomania is not nearly so favorable as that of alcoholomania or even morphinomania. Cocaine exhausts the mental capacity more rapidly than either morphine or alcohol; it takes a greater hold on the brain and nervous system, reducing his intelligence and benumbing his faculties, setting up a moral palsy which seems to annihilate inhibition and to deprive the victim of all desire for deliverance. There are, however, exceptional cases which exhibit a strong wish to be cured, which are hopeful and have been delivered under treatment at home.

Treatment.—ACUTE COCAINE POISONING.—If the poison has been swallowed the stomach syphon-tube should be at once applied and the contents of the organ evacuated. The patient should be placed in the horizontal position on his back. Tannic acid, iodine, or charcoal may be given as possible chemical antidotes. Stallard advises the stimulation of respiration and circulation by flicking the chest and face with hot and cold towels, as in opium poisoning; but I cannot say that I have seen benefit from this practice unless it has been done

lightly and occasionally for a minute or two. Ammonia or ether inhaled, drunk by the mouth, or introduced into the rectum, or administered hypodermically, is useful, as also is the administration of caffeine or coffee. The addition of small quantities of alcohol, in the form of 5- to 10- drop doses of tincturæ cardamom. comp., spirit of chloroform, or tincturæ lavandulæ comp. (separate or combined), is sometimes serviceable when coffee cannot be easily taken. Chloroform may be inhaled to relieve the spasm. Strychnine, in minute doses ($\frac{1}{100}$ grain), with or without a couple of drops or so of tincture of digitalis, is also of value. Some authors report apparent benefit from intravenous injection of normal saline solution; but I think caution is requisite, owing to the risk of embolism in the lungs.

When the blood-pressure has been raised or there is alarming respiratory spasm, a drop-dose of nitroglycerin, at intervals of half an hour if required, sometimes acts excellently. Clifford Allbutt says that the inhalation of oxygen and artificial respiration against the asphyxia may be indicated. I have found sips of hot water; and, where this could not be taken by the mouth on account of insensibility or collapse, hot-water enemata, of 3 to 4 ounces, of substantial aid. External applications, as hot as can be borne, such as a bottle, or jar, or tin filled with hot water and covered with flannel to protect the skin, I make it a rule always to apply, especially in unconsciousness, and, indeed, almost from the first.

CHRONIC COCAINE POISONING, OR COCAINOMANIA.—The treatment of the cocaine habit, or chronic cocaine intoxication, is very much more difficult. It is more essential to have complete control of the cocainomaniac and his actions

than even in chronic alcohol or morphine mania. There is less to work upon in the brain- and nerve- centres of the chronic cocaineist than in those of the chronic alcoholic or chronic morphinist. There is less mental and moral elasticity, less desire to be freed from the narcotic bondage, less consciousness of the bondage itself, a more helpless and hopeless wreck being difficult to find. Cocainomaniacs, however, are, in a few cases, cured without seclusion. In these hopeful cases there generally has been a greater stock of inhibition from the first. Again, the indulgence having been periodical and ordinarily provoked only by some recurrent neurotic pain or distress and leaving intervals of shorter or longer non-narcotic consumption between, inhibition has not been so paralyzed, and thus there has been more resisting power left. In the latter group of cases it is imperative to direct the treatment to the abolition or counteraction of the exciting influences.

In the mass of cases the main hope of cure rests in therapeutic seclusion. The patient must be treated as a diseased person. Diet, at first simple and readily assimilable, should be carefully attended to. Milk, with soda- or lime-water and effervescent if nausea and emesis are present; arrowroot or other farinaceous or malted food, and other peptonized preparations are excellent. Gradually, broths and plain soups, oysters, fish, poultry, and, lastly, mutton and red meat, with an ample supply of fruit and vegetables, may be given. But there are cases in which a non-fish-and-flesh dietary agrees better with the patient. Each case must be carefully observed to determine the most suitable dietetic instructions.

In the first week exercise and fresh air may usually be insisted on, with

massage to improve the wasted condition of the muscles. Meals should be regular, and exercise graduated.

Alcoholic beverages are best avoided; and, though in a few cases tobacco in limited quantities may be allowed to aid in staying the morbid impulse or crave, most cocainomaniacs would be better without it in any form. Tobacco is apt, in many patients, to impair digestion and depress the heart's action, the healthy state of both vital processes being points of the highest importance in the treatment of this mania.

To combat the wearing insomnia of most cases I know nothing better than the hot, wet pack. Of all the medicinal hypnotics, I have found phenacetin the most useful, in doses of 5 grains, repeated, if necessary, every hour; no more than 3 doses (15 grains) to be taken in one night. Other physicians have found chloral and sulphonal serviceable.

An important practical point is the method of complete withdrawal of the cocaine, which complete withdrawal is essential to cure. In most cases I have not felt justified in immediate withdrawal, though I have done this where practicable. I spread the reduction period over from seven to nine days, beginning, whatever the quantity which had been taken daily or how long, with a reduction of one-half. Dr. Welch Branthwaite informs me that in five cases he at once, after only one dose, stopped the cocaine, without trouble. These were cases in which morphine had also been freely used. In the cases in which I gradually reduced the dose of cocaine, morphine had not been habitually taken in large doses. Where morphine is also freely and regularly taken, it is easier to withhold the cocaine without delay.

The sudden removal of the drug is the first step, with sharp elimination through the skin, kidneys, and bowels. The continuous activity of the skin from hot air, sweating, and baths is essential, and this should be kept up for a long time. Narcotics are dangerous and are seldom of any value. Infusion of cinchona-bark is very valuable, and can be used for a long time. Arsenic appears to be the best of all the mineral tonics, and acids are also excellent.

Among foods, meats are to be used sparingly at first. The patient should remain in bed, reclining at full length most of the time during active treatment. Muscular exercise by massage for an hour a day should be given, or a walk in the open air with an attendant or a few moments' exercise with ropes and pulleys. Daily baths should be continued with regularity and care. Persistent watchfulness over all acts of the patient should be kept up for 6 or 8 weeks; then a rigid course of living and diet arranged, and its importance insisted upon, for a long period to come. T. D. Crothers (Phila. Med. Jour., May 28, '98).

All complications must be attacked, but, in the main, besides hygienic measures, nervine tonics are indicated in the endeavor to restore the lost energy and will-power which really constitute the disease. Of these tonics nux vomica and strychnine are the most effectual. Arsenic also is useful. I have found in this, as in other forms of narcomania, that an occasional replacement of the stronger nerve-tonics by milder ones is advantageous; I mean such as quinine, calumba, and gentian. Galvanism has, in appropriate cases, its value.

Though it is often asserted that 3 to 6 months suffice to effect a cure, my observation has been that 12 months constitute the shortest time in which such a result can be hoped for. There are, at the same time, a few exceptional cases in which a good result has been secured in a shorter period.

Medico-legal Relations.—As many cocaineists will not apply for curative detention of their own accord, it ought to be the duty of the constitutional authorities to lay hold on these miserable and utterly helpless diseased persons, and insist on their reception and therapeutic seclusion for a given time, in a retreat, home, or hospital provided for the special treatment of such cases, with provision for persons with limited resources and for the very poorest. Such a provision would, in the long run, prove as economical as it would be invaluable to the welfare, physical and moral, of the whole community.

I am unaware of any trial for murder or for administering cocaine with intent to injure another person; but cocaine has been employed to commit suicide. It has been stated recently that forty cocaineomaniacs appeared in the police-courts of Chicago within the period of a few months in 1897. The habit was said to have been induced, in some cases, by the use of popular preparations as cures for colds, etc. In the charters of various special institutions in the United States power is given to the managers to receive and compulsorily detain habitual inebriates who are addicted to excess in any narcotic or inebriant, including cocaine; but, in England, only excess in alcoholic liquors renders applicants eligible for admission into retreats under the voluntary provisions of the Inebriates' Acts.

NORMAN KERR,
London.

COFFEE AND CAFFEINE.—The seeds or berries of *Coffea Arabica*, so extensively employed for the preparation of the beverage, are not officially recognized except as the main source of caffeine. A fluid extract of the green

berry was formerly employed as a stimulant, however, and the infusion is now considerably used for the same purpose in the treatment of shock, poisoning, etc.

Before it is roasted coffee contains caffeine, caffeotannic acid, and—according to Palladine—an alkaloid: caffeine. During the roasting process, however, a volatile oil is developed, which, with the other substances, termed, collectively, “caffeine,” give the coffee its agreeable aroma.

Administration and Dose.—The infusion affects its users in different ways, some tolerating large quantities, others feeling the influence of one-half cupful. There is, therefore, no special dose to be recommended.

The fluid extract of green coffee may be given in doses varying from 1 to 2 drachms.

Physiological Action.—Marshall and Hare have studied the action of the empyreumatic oil of coffee. The percentage of oil obtained from an average browned coffee is 11.6 per cent.; in consequence, an ordinary breakfastcup of coffee contains about 45 minims of the oil, provided all the oil in the coffee used is extracted. In their opinion, the oil possesses none of the powers of a toxic character heretofore supposed. The pure oil increases the pulse-rate by direct cardiac stimulation in small doses, and lowers pulse-rate in large doses by a direct depressant effect on this viscus. On the highly-developed spinal cord of the frog it causes increased reflex activity; but, on the mammal with a well-developed brain, drowsiness and sleep.

The virtues of coffee, in the wear and tear of active life, are entirely subjective, and depend upon a general excitation of the higher centres, and chiefly upon its powerful exhilarant action upon the mental processes. It must be said, however,

that the assumed ability of coffee to replace food, or to increase the power for work without corresponding tissue-destruction, is deceptive. While a moderate consumer of coffee may be assisted by the stimulating action of the beverage, an intemperate consumer may be capable of performing prodigious feats of strength and endurance, but, nevertheless, at the direct expense of his tissues.

Prosorowsky studied the influence of coffee and some of its substitutes upon pathogenic micro-organisms, and concluded that coffee possessed incontestable antiseptic properties; in this respect it is superior to both its substitutes, rye and acorn coffee, the acorn being the more active of the two latter. The antiseptic action is due to the empyreumatic substances formed during roasting, and also partly to caffeotannic acids, the presence of which is alone capable of explaining the antiseptic action sometimes shown by infusions of raw ground coffee. A cup of coffee left in a room remains free from bacteria for over a week.

Poisoning by Coffee.—Rugh witnessed a case in which profound toxic effects from the drinking of large quantities of strong coffee were observed, a number of symptoms being those of beginning *mania a potu*. The patient's pulse was 96 and full, but weak; his respirations shallow and numbering 24 to the minute. The pupils were normal, the tongue slightly coated, the bowels regular; the skin moist, but not flushed; his expression was agitated with the fear of some impending danger. His muscles were in such a state of tension that, upon the slightest movement of arms or legs, clonic spasms occurred, though none was present when he lay perfectly relaxed, which, however, his exceedingly-nervous condition would not allow him to do. If he tried to sleep, he would be seized with

hallucinations just before losing consciousness, imagining that disasters were about to overtake him and seeing all kinds and shapes of images and objects. Then he would start up with fright and find himself in the greatest nervous excitement. When he stood up, he could close his eyes or look at the ceiling without wavering. His knee-jerks were slightly exaggerated, but sensation was perfect.

Case in which 2 cupfuls of an infusion made of 2 handfuls of coffee produced intense general tremors, lasting, in spite of bromide treatment, twelve hours after all other symptoms had disappeared. Cohn (*Therap. Monats.*, Mar., '89).

Therapeutics.—Coffee infusion is a most valuable stimulant for cases of narcotic poisoning, opium, belladonna, chloral, etc. While it may prove effective when administered by the mouth, it acts with far greater rapidity when administered by rectal injection. It may be given *ad libitum* in such cases, and its effects will appear sooner in proportion as the infusion is strong.

The rapidity of absorption is enhanced if the temperature of the infusion approximates that of the intestine (100° F.), since cold or heat produce momentary shock from which the intestinal walls must recover before the absorption can begin. (Sajous.)

In the collapse of anæsthesia, the toxic effects of venomous stings and bites, it is an invaluable adjuvant when employed by rectal injection. It sustains all the vital functions while the poison is exerting its effects, and carries the patient through the ordeal.

Caffeine.

Caffeine should be obtained from the dried seeds of coffee, but the caffeine of the drug-stores is really theine, since it is cheaper to manufacture the alkaloid from damaged tea than coffee.

It occurs as long, fleecy crystals, silky in appearance, having no particular odor and bitter to the taste. It is soluble in 80 parts of water and fixed proportions of ether, chloroform, and very soluble in boiling water. Caffeine is closely allied to theobromine, found in cacao, coca, and other plants.

Administration and Dose.—Citrated caffeine is frequently employed, owing to its greater solubility; but, Tanret having shown that the addition of equal proportions of the benzoate or salicylate of sodium caused a marked increase of solubility, this mode of prescribing the drug is now often used.

A pleasant preparation is the effervescent citrated caffeine (U. S. P.), made by "trituration together 10 parts each of caffeine and citric acid, 330 of sodium bicarbonate, 300 of tartaric acid, and 350 of sugar, making the powder into a paste with enough alcohol to make 1000 parts, passing the paste through a No. 6 sieve, drying it, and reducing it to a coarse powder. It must be kept in well-stoppered bottles." The dose is from 1 to 3 drachms.

Physiological Action.—Cohnstein has formulated the following conclusions, which agree with those of most observers: 1. In small doses caffeine produces an increase of the arterial pressure, while larger amounts prevent this increase. 2. The influence upon the blood-pressure is the result of the changed condition of irritability of the vasomotor centre, caused by the caffeine. 3. Caffeine has a direct action on the heart, showing itself in the pulse-frequency and wave-height, first as an irritation and then as a paralysis. 4. The heart-muscle is affected by caffeine in precisely the same manner as the skeletal muscle.

As to the effects of caffeine on blood-pressure, Gaetano Vinci found that in

all cases there was a rise of blood-pressure, whether the drug was administered by the mouth, intravenously, or hypodermically, with a consequent fall of pressure only in rabbits. In dogs and rabbits subjected to repeated blood-lettings, there was a constant rise to the normal, and often far above. In dogs suffering from inanition there was a constant elevation of blood-pressure proportionate to the weakness of the animal, except in cases where the lowering of vital forces had gone so far as to affect the heart-muscle.

Schneider found that after therapeutic doses caffeine could not be detected in the urine of cats or men, but that after comparatively-large doses it was readily obtained. Contrary to the opinion of Maly and Andreasch, he thought that the greater part of the drug was destroyed in the body. The discrepancy in the results of these various investigators may have been due, according to C. R. Marshall, to differences in the dose administered, the animal used, or the methods of estimation of the alkaloid employed.

Caffeine acts chiefly as a stimulant to the nervous system. In this manner it affects the action of the heart, causing the beats to become stronger, and in some cases more rhythmical; but, unlike digitalis and strophanthus, it has no specific action on the inhibitory nerves of that organ. Its action on the vasomotor centres is marked, causing contraction of the vessels and increased tension in the same, the blood-pressure rising. Pawinski (*Zeitsch. f. klin. Med.*, B. 23, H. 5, 6, '94).

Caffeine facilitates muscular labor by increasing the activity not of the muscle itself, but of the corresponding cerebro-spinal centre. As a consequence of this double action on the cerebrum and medulla, the sensation of effort is diminished and keeps off fatigue. The drug further prevents loss of breath and palpitation due to severe muscular effort. It does not check tissue-waste. Caffeine

allows more exertion through a kind of physiological economy. The drug would seem to place a person untrained in the position of one who had been subjected to perfect physical training. The ingestion of food allows of a certain amount of exertion, but fatigue comes on before the assimilated products of digestion are used up, and thus a reserve is left. Caffeine seems to use up more or less of that reserve, and hence the drug is beneficial only temporarily. Germain Sée and Lapicque (*Bull. de l'Acad. de Méd.*, Mar., '90).

Caffeine is thought by some observers to be one of the drugs instinctively desired by man, because of its exciting influences. Caffeine in small, repeated doses, according to this view, may be advantageously prescribed to soldiers on the march, as it increases muscular action and promotes the activity of the motor-nervous system, both cerebral and medullary. The result of this double action is to diminish the sensation of effort and to prevent fatigue. It prevents shortness of breath, with resultant palpitation. In this manner it supplies vigor to one who is engaged in severe and prolonged exercise.

Caffeine and theobromine act as direct excitants of the renal parenchyma. In contrast with the saline diuretics, which appear chiefly to provoke elimination of water and at the same time of salts, and especially chlorides, the xanthin bodies increase the elimination of nitrogenous elements, and specially urea and uric acid. Anten (*Arch. Inter. de Pharm. et de Thérap.*, vol. viii, fasc. v and vi, 1901).

Poisoning by Caffeine.—James Ferguson observed a case of tonic spasm following a medicinal dose of citrate of caffeine, repeated three hours later for severe headache, which became more violent than before. There was jerking of the hands and forearms, the fingers began to be rigidly clenched, and shortly after

the head was seen to be drawn to one side, with the jaws tightly fixed together. At this stage the author found the fingers of both hands as described, and the muscles of the face tightly drawn, but with some imperfect articulation by this time possible. Friction of the affected parts did some good, and a dose of 30 grains of chloral was ultimately followed by recovery of control over the muscles. There had been no loss of consciousness throughout. The patient's sensation had been chiefly one of great faintness and nausea. The author suggests that the use of the drug be watched, since it has now become a popular remedy for headache.

Therapeutics.—European observers—Huchard, Ferrara, and others—state that caffeine, given by the mouth, does not, even in large doses, show its best effects, because it is eliminated with great rapidity. The hypodermic method is the best, and is painless, producing no cutaneous reaction.

In diseases of the heart—both those depending on degenerative processes in the muscular fibres and such as are termed functional—the action of caffeine is striking and beneficial. In these affections the use of digitalis is only indicated during a later stage of the disease, when the heart is no longer capable of fulfilling its duties, when œdema and dyspnoea have set in. Caffeine is further of great use in attacks of dyspnoea, such as are observed in cases of sclerosis of the coronary arteries, and also in cases of cardiac insufficiency following on overexertion, severe moral shock, or febrile maladies.

Dropsy.—In dropsical effusions resulting not only from heart affections, but from disorders of other viscera, the diuretic properties of caffeine frequently manifest themselves advantageously.

Case of chronic peritonitis in which, under pure caffeine, there was always observed a markedly-increased diuresis, but with caffeine-sodium salicylate the opposite effect was seen, the caffeine diuresis being suppressed by the salicylate. Caffeine produced its most marked effect after a course of small doses of salicylates. The use of caffeine alone made tapping of the ascites unnecessary, owing to the absorption of all the œdema, which, on the other hand, was increased by the use of salicylates. Caffeine recommended with or without digitalis in all cases of venous engorgement with intact kidneys in order to remove the œdema by diuresis. Siegert (Münch. med. Woch., May 25, '97).

In cardiac dropsy digitalis is the most useful drug, but when it does not afford relief caffeine may be of valuable service. Case in which the heart was greatly enlarged, and the impulse strongly marked, the apex-beat being in the seventh space in the anterior axillary line. There were signs also of dilatation of the aorta. At the apex was a loud and long systolic murmur. The caffeine was used according to the following formula:—

R Caffeinæ, 5 grains.
Sodii salicyl., 4 grains.
Aq., ad 1 ounce.—M.

Given twice daily, this mixture afforded considerable relief. Tickell (Clinical Journal, Feb. 2, '98).

In cardiac and renal disorders the effect of caffeine is usually as follows: With doses of 3 to 4½ grains two or three times a day, the blood-pressure rises steadily, slowly, and the quantity of urine is increased. Œdema is lessened, but very slightly. Between the fourth and the sixth day the patients begin to complain of a sense of constriction in the chest, dyspnoea, and restless nights. In some cases it can be made out by auscultatory percussion that the heart has diminished in size in all its diameters; this is a sign of impending tetanus of the cardiac muscle, and the caffeine must be at once omitted. Caffeine continues to be excreted in the urine for at least ten to fifteen days after the last dose is taken. The more the kidneys are dis-

eased, the slower it is excreted and the greater is the danger. Caffeine acts exactly like strychnine on the spinal cord, the striated and especially the cardiac muscles. Zenetz (Wiener med. Woch., Dec. 9, '99).

FEBRILE MALADIES.—As a stimulant in febrile diseases, enteric fever, pneumonia, scarlatina, diphtheria, etc., caffeine is of great value. It supports the patient's vital powers and the cardiac action, and assists him in resisting the tendency to collapse.

Caffeine is very valuable as a cardiac stimulant in the post-febrile stage of typhoid. Two to 4 grains every four hours should be given. J. B. Walker (Annual, '90).

The adynamic state of typhoid fever and pneumonia is favorably influenced by hypodermic injections of caffeine. Benzoate of soda is added to the aqueous solutions of caffeine, and as much as 30 to 45 grains in six to ten injections may be given daily without bad results. Henri Huchard (Revue Gén. de Clin. et de Thér., June 20, '89).

In acute diseases of children it is to be recommended as a remedy *par excellence*, children supporting it better than any other. Subcutaneous injections to administration by the mouth preferred, 6 grains being given daily in two injections. Bruneau (Thèse de Paris, Feb., '94).

BRONCHIAL AFFECTIONS.—Caffeine is valuable in bronchial asthma and in bronchitis associated with spasm of the bronchial tubes. When a paroxysm of asthma is present, Skerritt gives 5 grains of the citrate of caffeine every four hours until relief follows. When the attacks come on regularly in the early morning, a dose of 5 or 10 grains at bed-time often serves to avert them. No ill effects have followed the treatment, even when continued for years. The drug sometimes causes slight wakefulness, but, as a rule, patients go to sleep without difficulty after the nightly dose of 5 or 10 grains.

CEPHALALGIA.—The various forms of headache, dependent upon nervous exhaustion, and the migraine of neuropathic subjects, are generally relieved by effervescent citrate of caffeine. It may be advantageously combined with antipyrine or the bromides.

COLCHICUM.—*Colchicum autumnale*, or "meadow-saffron," is a native of Europe and Great Britain, and constitutes a remedy of great repute abroad, though in America it, of late years, has fallen largely into disuse, not through any lack of intrinsic therapeutic worth, but because of the number of new substitutes offered. Indeed, the drug appears to have passed entirely out of the recollection of the majority of teachers, as they are so unfamiliar therewith as to deny it proper attention.

Both the bulb of the root (corm) and seeds are employed medicinally, and any choice between the two probably lies with the former, inasmuch as it yields more of the alkaloid colchicine. The corm is about one inch long, ovoid, flattish, with a groove on one side, wrinkled and of brownish hue, internally white and solid; inodorous, with sweetish, bitter, acrid taste. It often appears as cruciform transverse slices breaking with a short mealy fracture—if very dark hued, or it breaks with a horny fracture, it is inert, and consequently useless. It yields its virtues to alcohol, but not so readily or completely as to vinegar and wine.

The seeds are at their best during late July and early August, which is the period of collecting. They are nearly spherical, one-eighth inch in diameter, of reddish-brown hue externally, white internally, and yield much the same bitter, acrid flavor as the corm.

Colchicein is a decomposition product

of colchicine, and is had as small, yellow needles; soluble in alcohol, ether, and chloroform; slightly so in water.

Colchicine appears both as an amorphous body and a yellow, crystalline powder melting at about 296.5° F.; insoluble in water, alcohol, ether, and chloroform; it is very bitter and highly toxic.

Colchicine tannate is a yellow powder, soluble in alcohol only.

Preparations and Doses.—Colchicum abstract (root, corm), 1 to 2 grains.

Colchicum extract, fluid (root), 2 to 8 minims.

Colchicum extract, fluid (seed), 3 to 10 minims.

Colchicum extract, solid (root), $\frac{1}{2}$ to 2 grains.

Colchicum extract, solid (root), acetic, $\frac{1}{2}$ to 2 grains.

Colchicum, powdered (root), 2 to 6 grains.

Colchicum, powdered (seed), 3 to 10 grains.

Colchicum-syrup, 1 to 4 drachms.

Colchicum tincture, acetated (root), 10 to 60 minims.

Colchicum tincture (seed), 10 to 30 minims.

Colchicum-wine (root), 10 to 60 minims.

Colchicum-wine (seeds), 30 to 120 minims.

Colchicein, $\frac{1}{130}$ to $\frac{1}{64}$ grain.

Colchicine, $\frac{1}{130}$ to $\frac{1}{30}$ grain.

Colchicine tannate, $\frac{1}{64}$ to $\frac{1}{16}$ grain.

Scudamore's mixture (carbonate of magnesia, 2 drachms; Epsom salt, 8 drachms; wine of colchicum, 4 drachms; peppermint-water, to make 12 ounces), 4 to 8 drachms.

Larger doses of wine may be employed, but the drug then becomes very actively purgative and likewise emetic.

Physiological Action.—In small doses

colchicum is a marked alterative and cholagogue, and further exercises some mysterious, but specific, action whereby it becomes sedative, and which cannot be accounted for, save in part, by its evacuant properties. It increases secretions generally, particularly those of the liver and the glands and mucous follicles of the intestines. In large doses it purges copiously, and may likewise prove violently emetic; yet many people will tolerate unusual quantities without any unpleasant effects. Again, it is not uncommon for colchicum to produce a marked degree of exhaustion—perhaps even to fatality—ere hypercatharsis and hyperemesis give warning that it is being pushed too far. The stools produced by the drug are of a highly-bilious character, and, while at first solid or semi-solid, perhaps enveloped with mucus, later they are soft, liquid, of high color, and may even assume a dysenteric character. Authorities are not in accord as to the diuretic powers; while some insist that it favors solution and excretion of uric acid and urea, others deny any such action. As a matter of fact, the drug does not always provoke diuresis; but this is to be accounted for, perhaps, by the character of the preparation employed or the mode of administration. Strange to say, alcohol inhibits the action of colchicum, yet the wine is the most active of all the Galenical preparations. Alkalies materially assist its diuretic and purgative properties, and, combined with potassium bicarbonate, not only is this observed, but also the antilithic powers of the latter are greatly enhanced.

Colchicum is one of the most valuable remedies in the uric-acid diathesis, and the prejudice against it is absurd; and, far from it being a vascular depressant, it often gives strength and regularity to a feeble and irregular pulse, especially in

chronic gout with acute exacerbations. Burney Yeo (*Brit. Med. Jour.*, Jan. 7, '88).

One of the very good reasons why it has failed in many hands is that it is generally given in purgative doses, which prevents its specific effects upon the circulation. In acute rheumatism or gout the circulation should be reduced with aconite or veratrum before giving colchicum. Goss (*"Mat. Med., Phar., and Special Ther."* '89).

In small therapeutic doses produces gastro-intestinal disturbances, the symptoms differing in degree only from those of poisoning. Before they come on, however, there is a lowering of the pulse-rate, sometimes as much as twelve beats per minute. Upon the skin it acts occasionally, producing, in some cases, diaphoresis, and, it is believed, the amount of this action is in inverse ratio to the effect upon the bowels. Any nervous symptoms, such as vertigo, headache, and muscular weakness, which may be present as the result of the colchicum, are probably sympathetic upon the gastro-intestinal irritation. It is evident that the drug influences the bowels powerfully, and probably in this way acts as an eliminative. But, with the minute doses often used with advantage in the disease, purging does not occur, and consequently increased elimination, if it takes place, must be through the kidneys; great interest, therefore, attaches to the influence of the remedy upon the urinary secretion. In considering this the effects of poisonous and therapeutic doses must not be confounded, for it is very evident that an irritation which causes suppression of urine may, when present in a much milder degree, produce an increased flow. When the drug purges freely it is very probable that elimination by the kidneys is lessened; and no account of this is taken by any of the observers who have studied its effect in the elimination of urea and uric acid; all content themselves with noting the proportion of urea and uric acid in the urine, when it is evident that the mere proportion, unchecked by the absolute amount of urine excreted in the twenty-

four hours, is no criterion as to the absolute amount eliminated. H. C. Wood (*"Therapeutics: Its Principles and Practice,"* '94).

By some observers it is stated that there is an increased elimination both of urea and uric acid, while by others it is denied. It is possible that difference in dietary of the patients may account for this discrepancy. Murrell (*"Manual of Materia Medica and Therapeutics,"* '96).

Full medicinal or larger doses produce great depression of the circulation, with a small, rapid, and thready pulse. The marked cardiac depression and collapse which occur when poisonous doses have been taken are more the result of the severe gastro-enteritis than of any direct action upon the heart. The nervous system is unaffected by medicinal doses; but large or poisonous doses may induce cerebral excitement. Large doses render the respiratory movements slow and shallow. Personal experiments are sufficient to satisfy the author that the excretion of urea and uric acid by the kidneys is considerably heightened under medicinal doses. Butler (*"Text-book of Mat. Med., Pharm., and Ther.,"* '96).

Colchicum induces fall of temperature during the period of emetocatharsis; when injected into dogs there is a marked fall in blood-pressure. The amount of urea and uric acid excreted in the urine is much increased by the drug; Lewins found the urea excreted to be almost doubled in amount. Biddle (*"Mat. Med. and Ther.,"* '96).

The most discordant statements have been made about the action of colchicum upon the renal secretion, but it has not been definitely shown that either the quantity or composition is altered. After death by poisoning, the alkaloid is found in the blood and in most of the organs of the body. Hale White (*"Mat. Med., Phar., and Ther.,"* '96).

Though the physiological effects of this drug are very similar to those of veratrum, yet one cannot be therapeutically substituted for the other. It produces much irritation of the fauces, with increase of saliva. It irritates the di-

gestive tract and produces these effects whether taken into the stomach or injected into the veins. In large doses it considerably increases biliary secretion, and at the same time purges powerfully.

Colchicum, it is well known, gives relief from the pain, inflammation, and fever of gout. But how? Does it cause the elimination of uric acid through the kidneys and so remove the condition on which the gout immediately depends? Since Garrod has experimentally shown that colchicum exerts no influence on the elimination of uric acid in gouty people, it is evident that the drug must control gouty inflammation without, in any way, affecting the condition on which such inflammation, in the first instance, depends. Hence, colchicum should be merely palliative, removing, for a time, the patient's sufferings, but in no way protecting him from their recurrence. Many who suffer from gout are of opinion that, while the medicine will remove altogether an existing attack, it insures the speedy return of another. Ringer and Sainsbury ("Hand-book of Ther.," '97).

Colchicine in a general way acts like colchicum, but the action of colchicine has not been determined with any degree of definiteness.

On the heart and circulation colchicine produces very little effect, though large doses cause a fall of arterial pressure and slight slowing of pulse, due to depression of the heart.

Colchicine, in poisonous doses, induces marked weakness, stupor, and lowering of bodily temperature; decreases reflex activity, not by depressing the sensory nerves as does colchicine, but by acting on the motor nerve-trunks. Leon (Univ. Med. Mag., July, Aug., '89).

Two or three hours after the intravenous injection of colchicine the symptoms of general poisoning appear. The first symptoms are nausea, followed by more or less vomiting and diarrhœa; next, alteration in the motility, taking on the form of ascending central paralysis. When the paralysis reaches the anterior extremities, disturbance of res-

piration occurs: the respiratory movements become greatly increased in power and greatly decreased in number, until death ensues, owing to arrest of respiration. In rare cases, immediately before death, convulsions occur, which are attributable to asphyxia. The heart remains beating for perhaps twenty minutes after breathing has been arrested. Jacobi (Schmidt's Jahrbuch, Sept.; Therap. Gaz., Oct., '90).

Colchicum and its salts are contraindicated when there is a great amount of debility, a profuse diarrhœa, and in asthenic gout. It is worthy of remark that most of the untoward effects chronicled from time to time have appeared in conjunction with the administration of wine of colchicum-seed. On the other hand, much of the corm, or "root," employed by manufacturers is worthless.

Therapeutics. — **RHEUMATISM AND GOUT.**—In all forms of sthenic rheumatism and gout the relief that colchicum gives is incomparably greater than that afforded by any other single remedy, but the mode in which it is best given, the period best suited for its administration, and even the patients for which it is suited are points which demand serious consideration. It is by no means an agent to be prescribed hap-hazard and indiscriminately, nor one which will, in all cases, produce equally beneficial results. The maxims laid down by Todd cannot be improved upon, viz.: Never give it at the outset of a paroxysm, not until the bowels have been acted upon by a mild purgative. Let the first doses, always, be small, and subsequently gradually and progressively increased. At first administer uncombined with any other remedy until assurance is had that it is not likely to disagree with the patient; and do not push to a degree that will excite nausea, vomiting, or purging: these should be regarded as in-

dicative of unfavorable operation. It may be regarded as acting favorably when, under its use, the volume of urine is increased; when an abundant supply of bile is discharged; when the fæces, though solid, are surrounded by mucus; and when the skin secretes freely. Its effects should be carefully watched, as it is likely to accumulate in the system. It is inadmissible where the patient is advanced in years, who has had several attacks and in whom the malady seems too deeply rooted to be influenced by the temporary administration of the remedy.

It is necessary to continue the use of colchicum for many days after the entire cessation of the symptoms; but the doses may be gradually diminished, and at the same time the intervals lengthened; also, if the malady does not give way by the time the bowels are affected by the drug, it is useless to push it further.

Gout is the one disease in which colchicum is almost universally recognized as a specific. It may be advantageously employed both as a preventive of the paroxysm and to lessen its severity when developed. It should always be borne in mind that, although looseness of the bowels may be useful, yet when colchicum purges the gouty patient actively it mostly fails in achieving the desired therapeutic result. Its action is most favorable when its influence is felt chiefly upon the skin and kidneys; and to effect this it is often well to restrain the tendency of the drug to act upon the bowels by combining it with opium. This is especially the case in debilitated subjects, in whom anything like overpurgation must be avoided with the most scrupulous care. By large purgative doses of colchicum the paroxysm of gout may often be suppressed, but experience has shown this use of the drug is dangerous, the suppression being sometimes followed by serious internal diseases, apparently due to a transfer of the gouty irritation. Between the paroxysms colchicum may be steadily exhibited to the gouty sub-

ject in small doses, and often great advantage is derived from its combination with potassium iodide; this combination is especially useful in irregular atonic gout such as is frequently seen in women of feeble nervous organization who have inherited the diathesis, but is sometimes present in robust men.

In the inflammatory variety of rheumatism colchicum is of but little value except in purgative doses. In subacute rheumatism the combination with potassium iodide is very useful. H. C. Wood (*"Therapeutics: Its Principles and Practice,"* ninth edition, '94).

It is better to reserve colchicum for the treatment of the acute paroxysms of gout, giving a little opium (as in Dover's powder) at night, particularly to relieve the pain and to procure sleep, enjoining perfect rest and quiet and using warm applications locally. In chronic gout and the uric-acid diathesis it is not as useful. Biddle (*"Mat. Med. and Ther.,"* thirteenth edition, '95).

While efficacious in chronic rheumatism and occasionally of some benefit in rheumatoid arthritis, it is of no value in acute articular rheumatism. Its value is more apparent in acute than in chronic gout, and in the first attacks than in succeeding ones. Chronic gout, as well as chronic rheumatism, yields better to a combination of potassium iodide than to colchicum alone. In combination with certain other agents this drug serves an excellent purpose as a cholagogue, full doses being frequently very effective in relieving ascites due to obstructive diseases of the liver. It is also sometimes employed as a drastic purgative in cerebral and portal congestion, although when given in doses sufficient for this purpose it occasions considerable nausea and abdominal distress. It has also been recommended in the treatment of gonorrhœa and chordee. Hypochondriasis resulting from renal insufficiency is frequently benefited by this remedy. Butler (*"Text-book of Mat. Med., Ther., and Phar.,"* '96).

Given during an attack of gout it most markedly relieves pain; in smaller doses, given between the attacks, it diminishes their severity. It is often very useful

for dyspepsia, eczema, headache, neuritis, conjunctivitis, bronchitis, and other conditions which, when occurring in those suffering from gout, are probably related to it. Occasionally it is combined with other cholagogues, especially if it is desired to give these remedies to a person who is the subject of gout. Hale White ("Mat. Med. and Ther.," '96).

Colchicum is a remedy of undoubted value in gout and the gouty diathesis. The larger doses of the drug should be reserved exclusively for able-bodied men of the brewer's-drayman kind, and the effect is marvelous, the patient usually being able to resume work on the third day; but the treatment is severe and produces persistent purging not uncommonly accompanied by vomiting. In less severe cases give 10 minims of colchicum-wine with 5 grains of potassium iodide in a mixture flavored with spirit of chloroform and syrup of orange-flower, three times a day; this often acts as a laxative, and produces a peculiar metallic taste in the mouth; many patients take this mixture at intervals all the year round. Murrell ("Manual of Mat. Med. and Ther.," '96).

The effect of colchicum on gouty inflammation is very rapid; a large dose will often relieve the most severe pain in the course of one or two hours, and soon afterward the swelling and heat will subside. While the pain is thus quickly subdued, the temperature of the body falls very little during the first day, but on the following morning there is generally a considerable decline, and often a return to a healthy temperature; should the fall be postponed a longer time, then on the second day after the use of the colchicum a continuous decline of temperature will take place, and all fever gradually disappear. There are two methods of employing the drug: large doses which extinguish the pain at once, and small doses which give the same result only after some days. It is sometimes used in chronic rheumatism and rheumatoid arthritis, but without any very apparent benefit. Ringer and Sainsbury ("Hand-book of Ther.," thirteenth edition, '97).

GENERAL MALADIES.—In dropsies—the anasarca of the aged, hydrocephalus, hydrothorax, anasarca following fevers, etc.—colchicum is often very efficacious, especially in combination with other diuretics and a diuretic alkali. It is one of the most satisfactory remedies in chronic and obstinate constipation, but the dose should be small, as the object is attained rather by gradual insinuation than by forcible impression. In gonorrhœa and other inflammatory discharges from the genito-urinary organs, in both sexes, in strangury, ardor urinæ, and irritable states of the bladder, it has been employed with great success. At one time it was held to be the most efficient agent known to therapeutics in removing tape-worm. In jaundice and chronic hepatitis it has a value, but requires to be combined with soap, alkalies, or mild mercurials.

Spasmodic attempts have been made toward popularizing the alkaloid colchicine, but with little success; it does not sufficiently represent the virtues of colchicum. It has found its best application in the treatment of rheumatic iritis, and its value here is greatly enhanced by combining with methyl-salicylate. It has also been employed subcutaneously in chronic rheumatism and neuralgic joint-affectations.

A valuable remedy, and in conjunction with small doses of calomel may be prescribed with advantage for gouty people who have had no acute manifestation of the disease, but who suffer more or less continuously from joint-pain. A pill may be taken at bed-time, or three times a day after meals, composed of: $\frac{1}{80}$ grain of colchicine, $\frac{1}{2}$ grain of calomel, and 1 grain of solid extract of henbane. In gouty neuritis a pill three times daily—of colchicine, $\frac{1}{80}$ quinine and extract of colocynth, of each, 1 grain—is recommended. Murrell ("Manual of Mat. Med. and Ther.," '96).

For hypodermic use the alkaloid may be dissolved in distilled water in the proportion of 1 to 560 minims, the dose being 15 minims; but the injection causes sharp burning pain. When deep, intramuscular injections have been tried in sciatica, the results have been unfortunate and unprofitable.

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COLD ABSCESS. See ABSCESS.

COLITIS. See INTESTINES.

COLOBOMA. See IRIS AND LENS.

COLOCYNTH.—This is the dried, decorticated fruit, freed from seeds, of *Citrullus colocynthis*, a perennial plant resembling the watermelon; it is also known as “bitter apple” and “bitter cucumber.” Though grown in gardens in England since 1551, the plant is a native of the deserts and places of southern and western Asia, and of Africa; it is likewise cultivated, medicinally, in Greece, Spain, Italy, and Japan. Two varieties of fruit are recognized pharmacologically: one termed “peeled Turkey” colocynth, imported chiefly from Smyrna, Trieste, and Spain, and “unpeeled mogador,” from different parts of India, Africa, and, to some extent, from the Persian Gulf and the Levant.

The fruit is globular, about the size of a small orange, yellow and smooth when ripe, and usually gathered just as the latter process is beginning, when it is peeled and dried quickly, either in the sun or by artificial heat. As found in the shops, it is in white balls that are very light and spongy; about three-fourths of its weight is claimed by the seeds, which are not employed medicinally, though sometimes used in small proportions for purposes of adulteration. The British Pharmacopœia demands a

test that shall prove the colocynth to be wholly oil-free as evidence that such adulteration has not taken place, since such is a seed-product solely. Colocynth is inodorous, nauseatingly bitter, and yields a glucoside termed “colocynthidin” and a resin known as “citrullin,” or “colocynthitin,” the latter not being identical, however, with the colocynthitis of Walz.

Preparations and Doses.—Colocynth pulp, powdered, 2 to 10 grains.

Colocynth extract, compound (colocynth, 16; aloes, 50; cardamom, 6; scammony resin, 14; soap, 14; and alcohol, 10 parts), 5 to 20 grains.

Colocynth extract, fluid, 2 to 5 minims.

Colocynth extract, solid, 1 to 3 grains.

Colocynth pills, compound (compound cathartic pills), 1 to 3 pills.

Colocynth pills, compound, with henbane, 1 to 5 pills.

Colocynth tincture (10 per cent.), 30 to 60 minims.

Colocynthidin, $\frac{1}{6}$ to $\frac{2}{3}$ grain.

Colocynthin resinoid (concentration), $\frac{1}{40}$ to $\frac{1}{10}$ grain.

Colocynthitin (citrullin), $\frac{1}{6}$ to $\frac{1}{2}$ grain.

Powdered colocynth is now but sparingly used, the extract serving a much better purpose.

Compound colocynth, or cathartic, pills, are made in two ways. First by making a mass of compound extract of colocynth, 130; powdered extract of jalap, 100; calomel, 100; and gamboge, 25; to make 100 pills. Second, by beating together colocynth-pulp, 4; Barba-does aloes, 8; scammony resin, 8 parts; and potassium sulphate and oil of clove, of each, 1 part. It is often used in form of powder in doses of from 5 to 10 grains, and is easily identified by the odor of cloves. The so-called “vegetable” compound cathartic pill drops the calomel

and gamboge, and substitutes leptandrin, resin of podophyllin, henbane, and oil of peppermint.

Colocynth pill with hyoscyamus is made by mixing 2 parts of the compound colocynth pill (second formula just given), with 1 part of solid extract of henbane. It is not so liable to gripe as is the pill colocynth compound, and the dose is the same as the latter: 5 to 10 grains.

The glucoside colocynthidin, which is identical with the *colocynthin* of Merck, appears as a yellow powder soluble in water and alcohol, and is frequently used in enema by mixing from 4 to 16 minims of a 4-per-cent. solution in glycerin and ale.

The concentration colocynthin is obtained by evaporation from an alcoholic tincture as a chocolate-colored powder soluble in alcohol only.

Waltz's colocynthitin is a tasteless crystal powder; but citrullin, which often obtains this title, is a yellowish, amorphous powder, soluble in alcohol, glycerin, and ether, and finds more use in veterinary practice than elsewhere, though it is sometimes employed for its cathartic effect, preferably by suppository or in enema, in general medicine.

Physiological Action.—Colocynth preparations and derivatives stimulate the secretions throughout the *prima viæ*, and in full doses are apt to produce considerable irritation of the large intestine, causing profuse watery evacuations. If given in excessive doses, fatality may be induced by provoking inflammation, leading, perhaps, to ulceration. The drastic effects of the drug and its tendency to cause griping are readily overcome by prescribing partly with other purgatives and partly with carminatives, more particularly extracts of henbane or belladonna or monobromated camphor.

The drug is likewise actively cholagogic, and to some degree diuretic.

Colocynth Poisoning.—This is, fortunately, very rare, less than a score of cases appearing in literature. Christison describes a case in which a teaspoonful and a half of the powder killed a man, and Huseman mentions an instance where 40 grains proved fatal, though another case of his recovered after 3 drachms had been ingested. The toxic symptoms are hypercatharsis, and evidences of powerful gastro-intestinal irritation. The treatment consists of administering evac-uants, demulcents, opiates, and stimulants.

Therapeutics.—This drug is chiefly employed for its stimulating effect upon the liver and the intestines, or when a rapid, efficient, drastic purgative action is desired. It renders the bile more fluid and watery, at the same time increasing the secretion of biliary matter.

GASTRO-INTESTINAL, DROPSICAL, AND GOUTY DISORDERS.—Colocynth is a favorite remedy in habitual constipation and various dyspeptic conditions; but it is contra-indicated, except in minute doses, in inflammatory conditions of the intestinal canal. In dropsical affections, too, particularly when connected with disease of the liver, it is often effective, particularly if a hydragogue action is secured by combining with a little elaterium. In fact, in most conditions accompanied by constipation or visceral obstruction the drug is eligible.

Colocynth is one of the most prompt and powerful remedies for the relief of enteric colic. It makes some very satisfactory cures in cholera infantum and dysentery, being especially indicated when the disease is attended by intense pain—when pain is a prominent feature of the complaint. And though the drug seems to influence the circulation of the lower bowel to a marked extent, it is more a remedy for neuralgic than for

circulatory disturbances, and relieves neuralgic colic magically in many instances; however, it is adapted to pain in any portion of the alimentary canal below the œsophagus, and will prove useful in many a case of gastralgia of neuralgic character. In minute doses it is serviceable in the treatment of constipation in children and delicate females when other remedies would be objectionable. Webster ("Dynam. Therap.," '93).

Is a favorite remedy in dropsical conditions to produce watery stools, in cases in which other resorbents are contra-indicated. Roth ("Mod. Mat. Med.," '95).

Is a good remedy in passive dropsy from visceral obstruction, provided the patient is not debilitated; also in dyspepsia when there is a bitter taste in the mouth, bloating of the stomach after eating, and colicky or sharp, cutting pains in the region of the umbilicus. For bilious or worm colic it is a very important remedy; likewise in many diseases of the liver. It does good service in chronic diarrhœa when the stools are slimy and attended with sharp cutting pain and distension of the abdomen. It is serviceable in some cases of dysentery and again in neuralgias of the fifth nerve. Locke ("Mat. Med. and Therap.," '95).

In small doses the drug acts as a stomachic, improving the appetite and augmenting the secretion of the whole gastro-intestinal tract; it is also a decided hepatic stimulant and cholagogue, and useful to produce abundant watery evacuations, as is necessary sometimes in the treatment of hepatic and renal diseases where there is constipation and ascites. Gastro-intestinal inflammation, pregnancy, etc., contra-indicate its use. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

The drug has been used to cause the disappearance of long-continued dropsies and fluid effusions, but this employment is not to be recommended. Griffin (Foster's "Prac. Therap.," vol. i, '96).

APOPLEXY, MANIA, AND CEREBRAL AFFECTIONS.—Here the drug is often particularly useful as a powerful cathartic and derivative, but requires to be exhibited in full doses and repeated

until it operates freely. Croton-oil is generally preferred, however.

HYPODERMIC ADMINISTRATION.—The claim has been repeatedly advanced that the glucoside, given subcutaneously, is actively purgative. Some experiments, lasting several months, undertaken for definitely proving or disproving this, were undertaken by responsible persons, in the laboratory of a large firm of manufacturing pharmacists and chemists, and the evidence was wholly negative.

COLON, DILATATION OF. See **INTESTINES.**

COLPITIS. See **VAGINA, VAGINITIS.**

COLPOPTOSIS. See **VAGINA.**

COMPOUND FRACTURES. See **FRACTURES.**

COMPRESSION OF BRAIN. See **HEAD, INJURIES OF.**

CONCUSSION OF BRAIN. See **HEAD, INJURIES OF.**

CONDYLOMA. See **SYPHILIS.**

CONGESTION OF LUNGS. See **PULMONARY CIRCULATION.**

CONJUNCTIVA, DISEASES OF THE.—The conjunctiva is more frequently inflamed than any other ocular tissue; it is not only exposed to invasion by hosts of bacteria, but it offers a favorable *nidus* for their development. The pathogenic micro-organisms may be carried into its folds in many different ways: through the medium of the hands, towels, handkerchiefs, etc., through the lacrymal passages, and from the nasal mucous membrane by direct continuity of structure.

Tears have the power of diminishing the number of the staphylococcus pyogenes aureus and the bacillus subtilis.

Their virulence, however, is not affected. The gonococcus and micrococcus prodigiosus were unchanged. Bernheim (Corres. f. schweizer Aerzte, Aug. 1, '93).

Investigations of one hundred healthy eyes. The normal conjunctiva always contains bacteria, among which the staphylococcus epidermis albus is found with such frequency that it must be regarded as a regular inhabitant of the conjunctival *cul-de-sac*. This coccus, though but slightly pathogenic ordinarily, may, under certain conditions, become harmful. Neither irrigation with distilled water nor instillation of a 1 to 5000 solution produces sterility of the conjunctiva. R. Randolph (Arch. of Ophth., July, '97).

Hyperæmia of the Conjunctiva.—Conjunctival hyperæmia may either be passive or active. Passive hyperæmia exists after paralysis of the cervical sympathetic, or as a result of some interference with the proper circulation of blood in the membrane, or it may be associated with disorders of the general systemic condition, especially gout.

Active hyperæmia is a prelude to all inflammatory conditions of the conjunctiva, but may be occasioned by the presence of a foreign body or a misplaced cilia, or by the irritative action of dust and smoke. It is a frequent exponent of some error of refraction or of muscular insufficiency, and is often associated with a catarrhal condition of the nose and throat and with disease of the lacrymal passages.

The conjunctival congestions described by Jonathan Hutchinson as characteristic of masked gout are usually confined to one eye. The conjunctiva becomes red, and the eyeball feels hot and pricks as if it contained sand. The attack may come on within half an hour of the meal which has disagreed, and it may last for a few hours or a day or two. The fugacious periodical episcleritis of Fuchs is the same disorder. In this the congestions come on rather suddenly and present themselves in the form of patches

of hyperæmia of the sclera and overlying conjunctiva. They may have a violet hue, and are associated with burning and itching. These symptoms are personally thought to be the indication of vascular changes deep in the ocular coats, which in their turn are significant of wide-spread arterial changes throughout the body. G. E. de Schweinitz (Maryland Med. Jour., June, 1900).

Symptoms.—There is a smarting, burning, and itching sensation in the eyes, the lids feel heavy, and there is a disinclination to prolonged near and fine work. On eversion of the eyelids the mucous membrane is found to be abnormally red and perhaps a little swelled, while the Meibomian glands, imbedded in the tarsus, are rendered indistinct by dilated meshes of blood-vessels. The injection of the vascular supply may be limited to the conjunctiva of the lids or involve that of the globe also. There may be a slight increase in the flow of tears, but there is never any discharge.

Treatment.—Treatment of hyperæmia of the conjunctiva resolves itself into the removal of the cause. If of passive origin, the removal of the obstruction to the circulation will be followed by the rapid subsidence in the undue vascularity. If of active, the correction of any existing anomaly of refraction or of muscle-balance, or the removal of any foreign body, will accomplish the same result. Dark glasses should be given to protect the eyes from irritating rays of light, and from dust and smoke, and a boric wash or some other mild antiseptic or astringent lotion will, with cold compresses, be sufficient to reduce the vessels to their normal size.

Inflammation of the Conjunctiva.—When an increased and perverted secretion is added to the symptoms of hyperæmia, the conjunctiva may be said to be inflamed.

All varieties of conjunctivitis are contagious, and, while they occasion certain fixed changes in the tissues, which permit of their being grouped into certain types, they have this peculiarity, that the secretion from one type when inoculated into a healthy eye may set up quite a different variety of conjunctival inflammation from that of the eye from which it was obtained; this, therefore, shows that the secretion of the different forms cannot be regarded as being specific, but that the type of inflammation set up by it depends upon other causes as well.

Corneal involvement is a common complication of all forms of conjunctivitis and must always be regarded in the prognosis, as its occurrence usually indicates that there will be a permanent disturbance in vision after the subsidence of the inflammation.

According to the nature of the secretion and the character of the pathological changes observed in the tissues of the conjunctiva, inflammations of that membrane have been divided into the catarrhal, diphtheritic, purulent, granular, and phlyctenular varieties.

Catarrhal Conjunctivitis.

Symptoms.—In the simple form the conjunctiva is red, vascular, and swelled, the vessels usually forming a large, coarse net-work. At first these changes are limited to the palpebral conjunctiva; but they soon extend to the retrotarsal fold, the caruncle, and semilunar folds, and finally to the bulbar conjunctiva. The surface of the membrane is smooth, serving to differentiate it from other forms of conjunctival inflammation. The eyelids are slightly swelled, and their edges reddened and covered with yellowish crusts, and bathed with an abundant secretion.

Severe cases are characterized by the involvement of the bulbar conjunctiva, and by an increase in the redness and swelling of the palpebral portion of the membrane and of the retrotarsal folds. The net-like formation of blood-vessels can no longer be differentiated; small hæmorrhages appear, scattered through the membrane, and there is a serous infiltration from both the superficial and deep vessels. This fluid collects in the submucous tissue and occasions chemosis.

The lymph-follicles may develop, and the papillæ of the conjunctiva become swelled and turgid and give to the membrane a rough and granular appearance.

In chronic forms the objective symptoms are not prominent. There is moderate swelling and congestion of the conjunctiva and but slight secretion, the symptoms being those of hyperæmia.

There is a constant sense of heaviness and a sensation of sand in the eyes; there is burning and watering, and vision is momentarily blurred by some of the secretion covering the pupillary area of the cornea.

Complications.—Secondary corneal involvement occurs in the aged, especially when the catarrh has persisted for years. The ulcers are usually at the limbus, and their formation is attended with pain and photophobia. They appear as small, round, gray points, which may become confluent and form a crescentic ulcer. These usually heal, leaving small, bow-shaped nebulæ. Iritis may also present itself, and is usually the result of keratitis; but it may also be seen in severe cases of conjunctivitis without involvement of the cornea.

In gouty persons there is a form of conjunctivitis to which the name of "catarrho-rheumatic ophthalmia" has been given, which is attended with great pain in the eyes and temples and great

photophobia. There is usually marked lachrymation, but no discharge.

Singular and rare conjunctival affection occurring in arthritic persons, and in those affected with arteriosclerosis, consisting of the onset of an active hyperæmia of the conjunctiva coming on suddenly, without appreciable cause, and disappearing spontaneously, the attacks almost always coming on during the night, lasting three or four hours, and recurring regularly two or three times at intervals of twenty-four hours. M. Trousseau (*Recueil d'Ophthal.*, No. 6, '96).

In four cases small spots on the conjunctiva observed which resembled the infarcts of Weiborn, but found to be mycosis colonies similar to actinomycosis; some yellowish little grains collected into small balls, sometimes covered with epithelium, were also seen. The symptoms were those of a slight conjunctivitis. Scraping sufficed to remove the colonies, but a culture was not obtained. Fuchs (*Annal. d'Oculist.*, Sept., '96).

Etiology.—Catarrh of the conjunctiva may be originated by any of the causes of hyperæmia of the conjunctiva. It may be the product of foul air or of poorly-ventilated rooms, especially when large numbers of people are crowded together, as in tenements, etc.; professions which expose the eyes to overuse or the prolonged action of irritative gases and vapor, dispose to it, or it may be set up by contact with a leucorrhœal discharge. It is common in warm and changeable weather, when it may assume an epidemic form. Staphylococci and streptococci are almost always present, and the diphtheritic bacillus likewise. Weeks has found small bacteria in "pink-eye," which, when inoculated upon the conjunctiva of the rabbit, has produced this form of catarrhal conjunctivitis.

In subacute catarrhal conjunctivitis the germ commonly found is a diplobacillus, $\frac{2}{3}$ millimetre in length by $\frac{1}{8}$ millimetre in breadth. With pure cultures

Morax was able to reproduce the disease in man. The diplobacillus personally observed in diverse conditions of the conjunctiva. It grows readily upon pig-serum and serum-agar, the serum being liquefied all along the line of growth, which broadens if the tube is kept in the oven, until in some cases the whole surface of the slant is broken down.

In the secretion the germ, while showing some individual variation in size, is, on the whole, quite uniform. The large, thick, double rod is the almost invariable form, each member of the pair frequently showing an indistinct subdivision at its middle. In culture there is more variety in the forms to be seen. The germ stains very readily, dilute carbol-fuchsin giving the best pictures. It is decolorized by Gram's method.

It is evident that the appearance of the eyes infected with this germ is anything but uniform, but in the great majority of cases the symptoms are subacute or chronic in character. They yield quickly to a $\frac{1}{8}$ -per-cent. solution of zinc chloride dropped into the eyes. H. Gifford (*Annals of Oph.*, vol. vii, No. 2, '98).

From epidemic occurring in Vittoria in 1899 the following conclusions drawn: 1. Pneumococcic catarrhal conjunctivitis is a contagious affection, which occurs endemically or in epidemics, attacks individuals at all ages, and usually runs an acute course of about ten days' duration, but may become chronic. It is of a rather benign nature, and rarely affects the eye itself. It is produced by Fraenkel's pneumococcus. 2. The cases personally observed during the aforesaid epidemic were essentially cases of the pneumococcic variety of conjunctivitis. G. Gonsalvo (*Gaz. degli Osped. e delle Clin.*, Sept. 30, 1900).

The Koch-Weeks bacillus of conjunctivitis may present itself in a particularly severe form, and be complicated by phlyctenules and even by corneal ulceration. Such cases are especially contagious, and extra precautions should be taken to prevent their spreading, particularly among the school-children. As a rule, they are controlled by the use of mild astringent lotions, and applications of 2-per-cent. solutions of nitrate of

silver. E. A. Shumway (Phila. Med. Jour., April 26, 1902).

The course of this variety of conjunctivitis is usually favorable, uncomplicated cases recovering in from one to two weeks. In adults, however, especially if there be a history of alcoholism, albuminuria, or diabetes, the disease may assume a chronic form. Both eyes are usually affected, either at the same time or the second eye a few days later. The disease may begin as an hyperæmia and slowly go over into catarrh, or the onset may be more abrupt. In institutions where there are poor hygienic conditions, the disease usually becomes chronic and epidemic.

Treatment.—Attention should be given to the general health. Any existing systemic disease, such as rheumatism, diabetes, or albuminuria, should be combated, shorter working-hours should be prescribed for professional men and more exercise recommended; the eyes must be properly protected from the light, air, and dust with smoked glasses, and they should be kept clean from discharge by frequent washings with boric-acid lotion; great relief may also be obtained from the application of ice-compresses. These are best applied as follows: 1. Several pads of gauze of three or four thicknesses, about the size of a silver dollar, are laid on a block of ice. The ice should be suspended in a receptacle with perforations in its bottom which will permit the water and any secretion from the compress to drain off into a jar beneath it. An ordinary kitchen-collander and wash-basin will answer very well for this apparatus. One of the pads is taken from the ice as soon as it has been saturated and is applied to the closed lids, removed in a few moments, and a fresh one substituted for it. 2. Compresses of absorbent cotton

which have been soaked in ice-water may also be employed. They should be squeezed out sufficiently to prevent any of the water trickling over the patient's face and neck. 3. Cold may also be applied by means of the ordinary douche or by holding a small cake of ice directly to the eye; but these should be discarded for the compress, as they can only be used intermittently.

To avoid repetition it seems well at this place to give the indications which call for the employment of hot and cold compresses, not only in the treatment of catarrhal conjunctivitis, but also of the other forms of conjunctivitis as well.

In hyperæmia of the conjunctiva, induced by ametropia or the presence of a foreign body, we have, in cold, a simple, but effective, means of restoring the membrane to its healthy condition. In these cases the douche or the compress may be applied over the closed lids, with the greatest advantage, for fifteen minutes at a time. The water employed should not be too cold, or excessive reaction may follow its use.

In the treatment of the milder form of conjunctivitis the membrane may be sprayed with a solution of boric acid and salt, the good effects of this plan being probably due to the fact that the liquid thus applied penetrates the deeper tissues and correspondingly increases the extent of the contact and prolongs the action of the drug. De Schweinitz (Amer. Jour. of Ophth., St. Louis, Jan., '94).

A 2-per-cent. solution of extract of suprarenal capsule will cause a certain amount of contraction of the blood-vessels in an eye not inflamed, while a 3-, 4-, or 5-per-cent. solution will produce a decided blanching of the ocular and palpebral conjunctiva within a couple of minutes after the application is made, even though the engorgement of the vessels be considerable. The contraction of the blood-vessels does not last long, however, and as they begin to dilate they re-

turn gradually to the condition existing before the application was made. Bates (*N. Y. Med. Jour.*, May 16, '96).

Aqueous extract of suprarenal capsule produces great bleaching of the conjunctiva, but after the astringent action has passed away the inflammation returns in greater force than before. Hansell (*Editorial, Phila. Polyclinic*, '97).

Attention called to effects of chloride of zinc upon cases of pneumococcic conjunctivitis. Simple instillation of a $\frac{1}{8}$ of a 1-per-cent. solution of this salt generally causes the pneumococci to disappear from the sac; and, if upper lid be everted so as to bring remedy into upper retro-tarsal fold as well as lower, a few applications almost always cure the worst cases. H. Gifford (*Archives of Oph.*, Nov., '98).

In the severer forms of conjunctivitis, when there is a purulent inflammation or an exudate, ice is the sovereign remedy. When employed in the manner indicated, disastrous results are not to be feared.

The direct application of ice to the lids affords the best means of getting rid of the chemosis and œdema of both lids and conjunctiva. Foucher (*Annals of Ophthal. and Otol.*, Jan., '93).

At the commencement of the disease the board-like swelling of the disease is, doubtless, one of the chief causes of pyrexia, and, as the swelling and induration prevent the cold from gaining access to the eye, it is necessary that the treatment should be energetic and prolonged. The compresses, therefore, should be maintained night and day in such cases, and should only be desisted from when a corneal ulcer threatens or the secretion becomes excessive. If either of these two contingencies should arise, the ice-compress should at once be substituted by the hot application, these being persisted in for fifteen minutes every two or three hours. The hot water will relieve engorgement of the corneal circulation induced by the intense chemosis of

the bulbar conjunctiva, and favor resolution of the cornea.

In the treatment of all forms of conjunctivitis nitrate of silver occupies a leading position, the strength of the solution employed being proportionate to the intensity of the inflammation and the quantity of the secretion. In the early stages, where the discharge is mucoid in character, it should be employed in the strength of from 2 to 4 grains to the ounce, and later, *i.e.*, when the discharge has assumed more of a purulent character, from 10 to 20 grains to the ounce.

It is always best to apply the silver directly by means of a swab, and when the stronger solutions are employed it should always be neutralized by means of sodium chloride. If corneal ulcer occur, atropine should be at once instilled into the eye. Many discontinue the application of the silver as soon as this complication occurs, but if the discharge be very marked and care be taken to apply the silver in the manner just directed, it will usually be found to exercise a most advantageous action upon the course of the disease.

Follicular Conjunctivitis.

Definition.—Follicular conjunctivitis is a form of catarrhal conjunctivitis attended by a great development of the lymph-follicles.

Symptoms.—The inflamed follicles appear as oval, pinkish prominences the size of a pin-head, in the retrotarsal folds, especially the lower. They may be very numerous and may be arranged in parallel rows. In a proportion of the cases they are but few in number, and are scattered over the conjunctiva. There is some photophobia and inability to do near work for any length of time.

Etiology.—Follicular conjunctivitis is frequently seen in epidemic form in schools and asylums, especially where

many scholars are massed together, scrofulous subjects being particularly prone to be affected. As there are frequently no subjective symptoms, the physician is often the first to discover the presence of the follicles.

Follicular catarrh is frequently noted among school-children who do not complain of their eyes; confusion may arise from confounding this innocuous inflammation with the dangerous trachoma. H. Cohn (Berliner klin. Woch., June 20, '98).

Pathology.—The follicles consist of a mass of round cells, identical with the lymphoid stroma of the conjunctiva. There is no capsule, and the epithelium is unaffected. In the acute form, when the secretion is abundant, the affection is contagious; but, when there is but little discharge, the follicles lie hidden in the *cul-de-sac* without giving rise to any acute symptoms, and contagiousness is not to be feared.

The disease is one of childhood and adolescence, and may be associated with acute or chronic catarrh, but usually with the latter. The follicles disappear totally after a time; so that the prognosis is favorable, notwithstanding the chronicity of the process and its tendency to relapse, which serves to differentiate the disease from trachoma, with which it bears a close resemblance.

Treatment.—Treatment is the same as for catarrhal conjunctivitis, with the additional indication of bringing about the disappearance of the follicles. This is best accomplished by insufflations of iodoform, aristol, or calomel. In stubborn cases excision or expression of the follicles has been recommended. The hygienic surroundings should be bettered, if need be, the health of the patient attended to, and all near work prohibited. All errors of refraction should be carefully corrected under atropine.

The confusion of diagnosis between follicular conjunctivitis and trachoma has led to an equal confusion in the treatment. In trachoma the essential element is lymphatic hyperplasia, and the treatment which he has found most successful has been based on the treatment of lymphatic enlargements in other portions of the body. First, so far as possible the cause of irritation, whether chemical, mechanical, or bacterial, should be removed. This often involves not only frequent irrigations of the conjunctiva with boric acid solution, but we should consider the physical condition and surroundings of the child. Cod-liver-oil and iodide of iron are valuable internally. Locally, on alternate days, he has found a combination of ichthyol, 15 minims (1 cubic centimetre); tincture of iodine, 1 drachm (4 grammes); glycerin, 1 ounce (31 grammes), to be of value. On the other days an instillation of 1 drop of the following combination may be made at home: Zinc sulphate, 1 grain (0.06 gramme); wine of opium, 8 minims (0.5 cubic centimetre); water, $\frac{1}{2}$ ounce (15.5 cubic centimetres). Alger (Med. Record, Jan. 24, 1903).

Vernal Conjunctivitis.

Definition.—Vernal conjunctivitis is a chronic catarrhal inflammation of the conjunctiva, usually occurring in children and adolescents, which is attended with the formation of characteristic lesions in the pericorneal and palpebral tissues.

Symptoms.—The changes at the margin of the cornea consist in an accumulation of the conjunctival epithelium with hypertrophy of the underlying connective tissue. This gives rise to large, reddish-gray prominences, which may readily be seen. Although located in the palpebral fissure, these may extend for some little distance into the corneal tissue; or surround the entire cornea. The tarsal conjunctiva is thickened in the neighborhood of the diseased

area; its papillæ are enlarged and present a characteristic mammillated appearance. When the lids are first everted, the conjunctiva is covered with a fine, bluish-white haze, which resembles a layer of milk. At the height of the process there is profuse lacrymation, but rarely any discharge. Considerable photophobia is complained of.

The disease usually becomes worse upon the approach of spring, the eyes being comparatively free from irritation in the winter. It is quite rare and generally affects males, being essentially a disease of childhood and adolescence. The prognosis is good, although the disease runs a very chronic course and may persist from ten to twenty years. It finally disappears, however, leaving no trace, except in rare cases, in which a faint haze may remain on the cornea.

Etiology.—The disease frequently occurs in malarial subjects of both sexes, and is at times seen in women with irregular catamenia. The primary cause is unknown.

Treatment.—The disease is incurable, and palliation of the acute symptoms represents all that can be done. Van Milligen, who has had excellent opportunities to study the disease in Constantinople, where it occurs more frequently than elsewhere, has employed a solution of acetic acid, 1 to 20 grains to the ounce, with marked benefit. I have obtained excellent results from the same remedy.

Spring catarrh is an attenuated form of trachoma, the affection of the conjunctiva of the lid being primary and the immediate cause of the hypertrophy of the limbus. Good results obtained from vigorous friction of the lid with mitigated nitrate-of-silver stick. Chibret (*Revue Gén. d'Ophtal.*, Mar., '93).

In vernal conjunctivitis, applications of nitrate of silver or sulphate of copper are not always indicated, and do good

only when the stringy, muco-purulent secretion is very abundant. In the pericorneal form the best treatment is massage of the cornea with mercurial ointment, made up with lanolin. Darier (*Annals of Ophth.*, July, '97).

As there is no discharge, the disease is not really a catarrh, and does not demand the same treatment as this class of cases. The eyes should be kept clean with a 10-grain-to-the-ounce solution of boric acid; dark glasses should be prescribed to protect the eyes from the light and other irritants, such as dust, smoke, etc. If there is much pericorneal injection, a weak mydriatic should be prescribed: either atropine in small doses or homatropine. Iced compresses diminish the vascularity and afford marked relief. Arsenic, quinine, and iron should be administered internally.

Extirpation of the hypertrophied papillæ by electrolysis, and obliteration of the superficial vessels supplying the growth in the limbus, have been resorted to with good results.

Purulent Conjunctivitis.

Definition.—Purulent conjunctivitis is an acute, contagious inflammation of the conjunctiva caused by infection with gonorrhœal virus, and attended by a copious, purulent discharge. It is one of the most dangerous and virulent diseases of the eye. The contagion is carried by micro-organisms, the gonococci of Neisser, which appear not only in the pus, but also in the superficial layers of the conjunctiva itself. The gonococci may be found in isolated groups, either in the pus-cells or epithelial cells, and their virulence depends upon the severity of the urethral disease at the time of infection; the more violent the latter, the greater the ocular inflammation.

Purulent conjunctivitis may be produced during any stage of the urethral disease, but about the third week of the

existence of the latter is the most dangerous period, the discharge being then very copious, thick, and noxious. The discharge from a gleet may, however, give rise to severe and even destructive gonorrhœal ophthalmia.

According as the affection occurs in adults or infants, it is called *gonorrhœal ophthalmia* or *ophthalmia neonatorum*.

Gonorrhœal Ophthalmia.

Definition.—Purulent or gonorrhœal ophthalmia is a specific purulent inflammation of the conjunctiva characterized by great swelling of the lids and conjunctiva, and by copious secretion of contagious pus, presenting a marked tendency to destruction of the cornea.

Symptoms.—The period of incubation varies, according to the intensity of the contagion, from a few hours to three days.

At first the signs of a simple catarrhal conjunctivitis may alone be present, but soon the lids become red and so tumefied and tense that the patient is no longer able to open them. The palpebral conjunctiva and retrotarsal folds also become intensely red and swelled, and the former is often speckled with hæmorrhages. The membrane becomes hard and granular, owing to an infiltration of seroplastic lymph into its substance. The bulbar conjunctiva soon becomes similarly swelled, forming a hard rim about the cornea. The discharge is at first watery and sanious, but soon changes to a yellow or greenish-yellow pus. The eye is painful to the touch, and there is intense pain in the eye and temple. The constitutional symptoms are often severe, the patients being generally in a weak and feeble condition. Slight fever is also present in some cases.

This stage—that of infiltration—lasts about three days, when the disease attains its height. The lids then become less

tense, the conjunctiva softer, and a copious purulent secretion follows. After a week the discharge gradually declines, the tissues undergo restoration, and, at the end of four to six weeks, beyond a condition of chronic inflammation of the conjunctiva, which persists many weeks, the parts resume their normal appearance. Cicatrices rarely follow.

At times the disease assumes more of a subacute type. All the signs of inflammation are then less severe, the palpebral conjunctiva being alone affected, and it is often only possible to diagnose these cases from catarrh of the conjunctiva by a microscopical examination. When the disease is particularly virulent, it may simulate the croupous type, a false membrane being formed, which gives the conjunctiva a yellowish-gray appearance.

In the prophylaxis of purulent conjunctivitis, which is generally gonorrhœal in character, great care must be taken not to contaminate the eye with pus from the urethra or vagina. In purulent ophthalmic neonatorum the eyes of every infant are first washed outside with mercury cyanide or bichloride, 1 to 20, and a drop of a 2-per-cent. silver nitrate solution is dropped into each eye. This, Credé's method, has greatly decreased the number of cases of gonorrhœal ophthalmia in infants. A. Trousseau (*La Presse Méd.*, March 26, 1902).

Complications.—The chief danger in purulent conjunctivitis is the implication of the cornea. It results from the pressure of the swelled tissues; the corrosive action of the secretion, including the invasion of the gonococci; and direct continuity of inflammation to the substance of the cornea.

At first the cornea may look dull and slightly clouded; but soon circumscribed areas of grayish infiltration appear, which soon become more dense and yellow, and then form ulcers. The ulceration usu-

ally occurs at the limbus, and may lead to rapid perforation. In many instances this is a relatively-favorable result, as further infiltration of the cornea is frequently prevented thereby. In other cases, however, the infiltration may form at the margin of the cornea and extend a considerable distance around its circumference, giving rise to a marginal ring ulcer. Sloughing of a great portion or even the whole of the cornea usually follows, and the eye is usually lost.

The ulceration may also occur at the centre of the cornea, when the whole cornea becomes opaque. As a rule, the greater the severity of the conjunctivitis, the greater the liability to corneal involvement, especially if the bulbar conjunctiva be much chemosed. As a rule, also, the earlier the corneal ulcers form, the more likely are they to result seriously.

Corneal ulceration usually appears on about the third day, but this depends upon the severity of the inflammation; in a certain number of cases it does not appear until late in the disease.

Iritis may supervene when the ulceration has extended to the deeper layers of the cornea or when perforation has occurred. It generally gives rise to great ciliary neuralgia, photophobia, and lachrymation.

The inflammation may extend from the iris to the other ocular tissues, and a panophthalmitis be set up.

Prognosis depends entirely upon the degree of implication of the bulbar conjunctiva, for, if this be much chemosed, corneal ulceration will probably occur and vision be seriously compromised.

Etiology.—Gonorrhœal ophthalmia arises through infection with gonorrhœal pus alone, the virus being conveyed directly from the genitalia to the eyes, or from a diseased eye of another person, or

from the patient's fellow-eye by the hand, handkerchief, etc.

The serious ophthalmias are those produced by streptococci or by an association of streptococci and gonococci, or by the combination of these two with others. The gonococci, when alone, are comparatively harmless (?) and yield to treatment, which should be prompt and vigorous, consisting of copious irrigations with potassium permanganate, boric acid, and cauterization with silver nitrate. This combination acts on all the various species of microbes which may be producing the ophthalmia. Chartres (*Arch. Clin. de Bordeaux*, Dec., '96).

Case of gonorrhœal conjunctivitis secondary to a gonorrhœa induced by intercourse during menstruation. Formalin proved effective. Hansell (*Editorial*, Phila. Polyclinic, '97).

There is a direct proportion between ease of transportation and a low rate of blindness, while a higher ratio is to be expected where travel is poor and inconvenient. L. Howe (*N. Y. Med. Jour.*, June 26, '97).

Sequelæ are the result of corneal involvement, for the conjunctiva is usually restored to a healthy condition; but, in the event of the corneal ulceration, all eventualities are possible; from a slight degree of opacity, on the one hand, to adherent leucoma, panophthalmitis, or even atrophy of the globe, on the other.

Treatment.—The chief indication in the treatment consists in carefully and frequently freeing the eyes of the copious secretion; for this purpose bichloride-of-mercury or boric-acid solutions should be employed very often. To do this properly will require the constant care of two intelligent attendants. The patient should be put to bed, and, if but one eye be affected, its fellow should be carefully protected. For this purpose the device of Buller answers admirably. This consists in a watch-glass held in place before the eye by strips of adhesive plaster. It should be removed every forty-eight

hours and the eye thoroughly cleansed with a solution of boric acid. The surgeon should warn the patient of the danger of carrying any of the urethral discharge to the eyes and should caution the nurses about exercising the most punctilious cleanliness as regards their hands, and care in the use of towels, handkerchiefs, etc.

It is the duty of every physician attending a case of purulent conjunctivitis to warn those living with the patient of the very contagious nature of the discharge from the eyes, and, where possible, to isolate both the patient and the nurse in charge. Johnson (Times and Register, Sept. 16, '93).

In gonorrhœal conjunctivitis, if only one eye is affected, the other should be hermetically sealed. The diseased organ should be washed, at least every half-hour, with a solution of mercury bichloride, 1 to 5000, or a saturated solution of boric acid, and, every four hours, the conjunctival *cul-de-sacs* should be thoroughly cleaned with pyrozone. In addition, ice-compresses, to be changed every few minutes, should be applied constantly, day and night, in the first stage. When there is severe pain and swelling, relief may be afforded by canthotomy, slitting the conjunctiva, or leeching the temples. In the second stage, when the conjunctiva has become velvety, the careful application of a 3-per-cent. solution of silver nitrate is best treatment. After its use the conjunctiva should be thoroughly cleansed with a saturated solution of common salt. In the third stage, when acute inflammation has completely subsided, the silver is replaced by crystals of zinc or copper. In all stages atropine should be used when there is any appearance of haziness or ulceration of the cornea. A. T. Haight (Chicago Clinic, xiii, p. 317, 1900).

Great care should always be exercised in washing the eyes of these cases, as the pus frequently spurts out like a jet when the lids are separated.

If the swelling of the lids prevents ready access to the *cul-de-sac*, canthop-

lasty should be performed, as this procedure not only gives access to the *cul-de-sacs*, but lessens the pressure of the lids, and gives room for the infection to spread.

In the first stage, ice-compresses should be applied constantly night and day and changed every few moments. In robust subjects or when there is intense initial pain or swelling, marked relief may often be obtained by leeching the temples.

In the treatment of fifteen cases of purulent ophthalmia good results were obtained by the mild and antiseptic method (silver, 5 grains; corrosive sublimate, 1 to 5000). Campbell (Harper Hosp. Bull., Detroit, Dec., '93).

In the second stage, when the conjunctiva has become velvety and the discharge purulent, the conjunctiva should be touched with silver nitrate (15 to 20 grains to the ounce of water), to reduce the swelling and the amount of secretion. The silver-nitrate solution should be applied by the surgeon to the conjunctiva of the everted lids and then neutralized with a saturated solution of common salt, as directed in catarrhal conjunctivitis.

Great importance of reaching all parts of the conjunctiva with 3-per-cent. nitrate-of-silver solution in gonorrhœal ophthalmia. Abadie (Bull. Gén. de Thér., Jan. 15, '95).

When cornea implicated, quinine sulphate, 4 grains to 1 ounce, with smallest possible amount of sulphuric acid; to be used in intervals, but not as a substitute for silver nitrate. Tweedy (Practitioner, Mar., '95).

Purulent ophthalmia and dacryocystitis successfully treated by potassium-permanganate solutions, 1 per cent. to 10 per cent. Case of diphtheritic conjunctivitis treated by crude petroleum-oil. Vian (Recueil d'Ophtal., Aug., '95).

Protargol in 10-per-cent. solution used for personal application in purulent conjunctivitis and 5-per-cent. solution for use at home. Furst (Fortsch. d. Med., No. 4, '98).

Protargol in 5-per-cent. solution is practically a specific against purulent conjunctivitis. A. Darier (Ophth. Klinik., Nov. 7, '98).

A 10-per-cent. ointment of the milky juice of the cassaripe plant is valuable in purulent disease of the conjunctiva accompanied by corneal ulcers. S. D. Risley (Phila. Med. Jour., Oct. 29, '98).

It is best to delay the application of silver so long as the conjunctiva is hard and infiltrated and the discharge is watery. A croupous membrane also contra-indicates its use.

In the third stage, when the signs of chronic conjunctivitis appear, the silver should be substituted by crystals of zinc and copper, but these should only be employed when the cornea is quite free from all signs of acute inflammation and ulceration. During the entire course of the disease, the cornea should be carefully inspected, and, at the first appearance of ulceration, atropine should be instilled. This drug frequently serves a double purpose in combating any existing iritis, as well as the corneal involvement. If corneal ulceration be present, great care must be exercised in making the applications of silver to the everted lids, as pressure on the globe might cause rupture of the ulcer. Care should also be exercised to prevent the silver coming in contact with the infiltrated cornea.

Ophthalmia Neonatorum.

Definition.—This is a purulent inflammation of the conjunctiva occurring in the newborn, characterized by great swelling of the lids and conjunctiva, and the copious discharge of contagious pus.

This is one of the most frequent of eye diseases, and is responsible for more cases of blindness than any other affection, the statistics showing that from 30 to 60 per cent. of the inmates of the different blind-asylums throughout the country owe their infirmity to its rav-

ages. Of the three hundred thousand blind in Europe, thirty thousand were rendered so by ophthalmia neonatorum.

Symptoms.—The disease usually appears on the second or third, more rarely on the fourth or fifth, day after birth. In the latter case, however, it is probable that infection is carried to the eyes after birth, either from the mother or the nurse or some other person suffering from gonorrhœa.

The active symptoms are the same as the gonorrhœal conjunctivitis, except that they are not so severe. The swelling of the lids is not so great and the secretion is less copious. The bulbar chemosis does not attain such a high degree, and corneal complications are not so frequent nor so serious.

The disease may occur in a severe type, with a tendency to invade the cornea; or it may run a milder course, without corneal complication.

In the mild form of conjunctivitis in the newborn there is little pus, much lachrymation, and moderate palpebral injection, although the pneumococcus is present. Parinaud (La Méd. Mod., Jan. 19, '95).

Pneumococcic conjunctivitis to be suspected when scarcely reddened palpebral conjunctiva, marked arborescent vascularization of ocular conjunctiva, with slight ecchymosis near corneal border; secretion more lacrymal than catarrhal and containing floating muco-fibrinous flakes. Gasparrini (Annali di Ottalmol., Jan., '95).

Bacteriological examination of 100 cases of infantile ophthalmia, clinically ranging from a simple catarrh to a severe blennorrhœa. The following organisms were found: Gonococci, pneumococci, and streptococci; possibly in some cases staphylococcus aureus and bacillus coli. The etiological importance of other organisms was doubtful. The severe cases of blennorrhœa were, for the most part, caused by gonococci; but there occurred cases in which, in spite

of most careful examination, gonococci were not found. The gonorrhœal cases always showed clinically certain peculiarities. The cases without gonococci were never complicated by corneal ulcer, and ran a much shorter and milder course. Also cases of slight and medium severity without gonococci showed after a few days' treatment marked lessening or disappearance of purulent discharge, whereas the pus of gonorrhœal inflammation seldom disappeared under two weeks. Gonococci were the cause of the inflammation in 41 of the 100 cases; in 25 of these the affection was severe. In gonorrhœal cases for days and weeks after pus has disappeared gonococci may be found in the conjunctival sac; so that the use of silver preparations must be continued long after purulent discharge has ceased. Groenouw (*Arch. f. Ophthal.*, B. lii, p. 1, 1901).

The prognosis depends upon the state of the cornea when the case comes under treatment. If this be uninvolved, the chances of recovery are favorable.

Study of forty cases of ophthalmia neonatorum; average duration of gonorrhœal cases, fifty-three days; average duration of non-gonorrhœal, thirty-six days. Francisco (*N. Y. Eye and Ear Infirmary Reports.*, Jan., '95).

Etiology.—The origin of the contagion is the morbid vaginal secretion, the infection, as a rule, occurring at the time of birth by some of the secretion of the vagina being transferred to the lids of the infant and being carried into the eye the first time that the child's eyes are opened.

Twenty per cent. of all cases of blindness are found in youth, and, of these, 20 to 25 per cent. are caused by blennorrhœa neonatorum. In 85 per cent. of these cases the affection begins within five days after birth, and, if immediately treated, 70 per cent. are cured. Early corneal complications are the gravest. Pflueger (*Corres. für Schweizer Aerzte*, Sept. 15, '95).

Catarrh of the newborn due to nitrate of silver studied. Results of 300 cases treated by Crede's method. In 4 out of

100 there was no reaction, in 73 the secretion had disappeared entirely on the fifth day, in the others it lasted longer. Irritation was not caused so much by increasing the number of drops as by using it on successive days. Small and ill-developed children are more sensitive to argentic nitrate than healthy ones. Catarrh for the first twenty-four hours is usually aseptic, and after that septic. Only 1 out of 300 cases had gonorrhœal conjunctivitis. H. Cramer (*Centralb. f. Gynäk.*, Mar. 4, '99).

Prophylaxis.—The great aim should be the prevention of contagion during birth. If this be done there is no disease in which prophylactic measures are so efficacious and the results obtained so gratifying. Since the adoption by ophthalmologists of adequate measures, the proportion of cases of ophthalmia neonatorum has been reduced from 7.5 per cent. to 0.5 per cent. Vaginal antiseptics should be employed before labor. Immediately the child is born, the lids should be wiped with a piece of lint saturated in bichloride solution (1 to 8000).

After the child has been washed, during which care should be taken that none of the water is permitted to gain access to the conjunctival sac, a drop of a 2-per-cent. solution of silver nitrate should be dropped into each eye. The solution of silver in this strength excites considerable irritation, and while its application should always be insisted upon in hospitals and the like, in private practice, where no gonorrhœal contagion is suspected, the douche before labor and the cleansing of the lids by bichloride solution, followed by a careful douching of the conjunctival *cul-de-sac* with boric acid will suffice.

In making the applications the child should be laid on its back and its head placed between the knees of the physician, while an assistant seated in front

should hold its body in his lap and secure the hands. The lids should then be gently separated by pulling on the skin of the eyelids above the upper and below the lower tarsus, and complete eversion of both lids performed.

Propensity of newborn infants to rub their eyes with their fists; source of contagion—face and hands, as well as eyes—to be cleansed at birth. Ayers (*Amer. Jour. Med. Sci.*, June, '95).

Theory advanced in favor of the method of Credé, that of direct inoculation of the eyes of infants by the vaginal secretions, opposed. It is contended that the lids are rolled inward to cover and protect the eyes until after birth, and that when they are opened the portions having any secretion from the vagina upon them are remote from the edges of the lids. Merely rendering the lids antiseptic is enough; instillation of silver solution is not prophylactic. A piece of cotton dipped in 1 to 100 mercury cyanide should be applied over the lids to disinfect thoroughly before bathing, and should be repeated after the eyes have been washed. De Wecker (*Jour. de Clin. et de Thér. Inf.*, No. 42, '99).

The douche fulfills the requirements of cleanliness, which are so essential. Critical case referred to which recovered under systematic irrigations with the douche of a 1-per-cent. solution of boric acid. In this and other cases the other well-known methods had been tried and failed. Holt (*Jour. Amer. Med. Assoc.*, Jan. 5, 1901).

Treatment.—The treatment is the same as has just been given under the gonorrhœal ophthalmia of adults, with the exception that the protection of the sound eye and the application of compresses are not, as a rule, feasible.

Gonorrhœal conjunctivitis in fifty-seven newborn infants treated with calomel. The gonococcus of Neisser was found in the discharge in all the cases. The conjunctival mucous membrane having been syringed with a 2-per-cent. solution of boric acid, and well dried with

absorbent cotton, was dusted with calomel. One day after the first application the discharge and swelling of the mucous membrane diminished, even in severe cases. Sometimes the dusting had to be repeated two or three times. The treatment lasted only for a week, and in neglected cases of long standing not more than a fortnight. The results were very satisfactory. Pukalof (*Wratch*, No. 27, '97).

In purulent ophthalmia in the newborn the lids are first cleansed, then 1-per-cent. to 2-per-cent. solution of copper sulphate applied; 5-per-cent. ichthylol salve is to be used three times daily. Elze (*Woch. f. Therap. u. Hyg. d. Auges.*, Nov. 11, '98).

Silver-nitrate solutions should only be used in the later stages of the disease, after the intense swelling of the eyelids has begun to subside and the discharge is more purulent. A 2-per-cent. solution may then be applied to the conjunctival surface and neutralized with salt solution. Nothing, however, should take the place of the constant cleansing. Solutions of protargol seem less reliable than silver nitrate. The edges of the eyelids and the surrounding skin should be protected with vaselin. In patients who are in poor physical condition, the application of heat will often prove better than cold. If the cornea becomes hazy and a small ulcer forms, the irrigation should be continued and a 1-per-cent. atropine solution applied three times a day, with hot applications. In some cases of marginal ulceration solution of eserine, $\frac{1}{2}$ grain to the ounce, may be used every four hours, but with care. In adults, if the disease has only affected one eye, the other eye should be at once protected by covering it with a small pad of absorbent cotton and gauze. C. H. Williams (*Boston Med. and Surg. Jour.*, Feb. 7, 1901).

The best results, as shown by an extensive investigation, were obtained when a 2-per-cent. solution of silver nitrate was used immediately after birth, following the suggestion of Credé. Only 0.65 per cent. were affected with the disease when this solution was used. Almost equally as good results were obtained from a 1-per-cent. solution of

sublimate, but weaker solutions were attended by higher percentages of ophthalmia. Furthermore, irritant effects from this drug are so rare that they are hardly worth considering, and substitutes for silver nitrate seem to be unnecessary. Recently protargol in 20-per-cent. solution has been employed with good results, and it is claimed that it is unirritating. In the treatment of this affection it is said that the stage in which a case of infantile ophthalmia is seen should be its worst stage. From the time when applications of a 2-per-cent. solution of silver nitrate once every twenty-four hours to the inner surface of the everted lids are begun the condition should commence to improve. Cold compresses are also useful. E. T. Collins (Practitioner, April, 1902).

Notwithstanding the application of Credé's method there are still a large number of cases of blennorrhœa in the newborn. This method was applied to 962 children born in the clinic for women in Berlin, and 1.5 per cent. suffered from blennorrhœa.

The clinic for diseases of women in Göttingen shows better results with Credé's method. In the period since 1888 there were 1917 births in which no single case of early blennorrhœa occurred, and only 3 of late infection, and all of these were slight. Gonorrhœa is a frequent disorder in the maternity; in a series of cases in which this infection was carefully looked for it was found present in nearly 25 per cent.

In no case did more than slight congestion of the conjunctiva follow the instillation of nitrate of silver, and this only when 2-per-cent. solution was used. When the method was first employed the stronger solution was used, but in the last 928 children a 1-per-cent. solution was instilled. The most important point in the technique is to instill the solution as soon after the child is born as possible. If an hour has passed, it may be too late to prevent the infection. It is probable that the neglect of this latter precaution has led to the reported failures in other clinics. Hirsch (Klinisches Jahrbuch, Bd. iii, H. 3, 1902).

Granular Conjunctivitis (Trachoma, Egyptian Ophthalmia, Miliary Ophthalmia).

Definition.—Granular conjunctivitis is an inflammation of the conjunctiva, characterized by the hypertrophy of the tissues and by the development of small pinkish prominences or granulations on the conjunctiva, the chief tendency of which is to undergo absorption and produce serious cicatricial changes in the lids.

Although it was generally supposed that the disease was introduced into Europe from Egypt by Napoleon's army in 1798, it was subsequently shown that the disease had actually been endemic in Europe several centuries before. Excellent descriptions of the disease were recorded by the ancients, and measures adopted by them for its relief have come to light again in our own day under the form of the operation of scarification. Nevertheless, to Napoleon is due, in large measure, the propagation of the disease, for it was doubtless owed to the frequency with which his armies came in contact with those of other countries, as well as with the civil population, that the disease spread so rapidly during the first part of the present century.

The Jews, the Irish, the inhabitants of the East, and the North American Indians are especially liable to the affection, while negroes are practically exempt.

Geographically, the disease occurs more often in Arabia and Egypt, while western Europe is more exempt than eastern Europe. In the United States it affects those dwelling in tenement-houses, and is associated with unhygienic surroundings in large cities. It prevails in the Western prairies, and is found scattered widely over the country. High altitudes seem to render a certain immunity to the disease.

Verification of the law established by Chibret concerning the immunity given by a high altitude. A certain elevation above the sea-level offers the best conditions for cure, but there is no absolute immunity. Sattler (*Revue Gén. d'Ophtal.*, Aug., '90).

In the City of Mexico trachoma is very rare. The hygienic conditions of the lower classes being of the very worst, it is the altitude of the city (6000 feet) that renders it free from this pernicious disease. Race has nothing to do with the question, as there are many foreigners living in the city who are alike free from any visitation of the inflammation. Chacon (*Gaceta Medica de Mexico*, June 1, '92).

Symptoms.—There is a great difference in the symptoms, not only on account of the intensity of the changes, but also from the rapidity of the course of the disease. The signs of irritation are greater, the quicker the course of the disease. Usually, the irritation symptoms are only moderate, but slight photophobia, lacrymation, and pain being complained of.

Not seldom the disease is so insidious that the subject does not know of its existence, the disturbance in vision due to corneal complication giving the first indication. This is especially the case when the disease occurs in eleomoscenary acute trachoma. Here the disease begins with marked inflammatory symptoms; the lids are œdematous, the conjunctiva swollen, and there is a rich secretion of pus.

Granular conjunctivitis may occur in either an acute or chronic form, according as it is or is not attended by the signs of acute inflammation.

Acute Granular Conjunctivitis (Papillary Trachoma; Chronic Blepharorrhœa).—This is rare in this country and should be differentiated from the violent exacerbations to which the chronic forms of the malady are liable. In this variety

there are all the signs of purulent conjunctivitis, with the development of the granulations. The lids swell and the conjunctiva, both bulbar and palpebral, becomes injected. The papillæ are enlarged, and the characteristic granulations are about the size of the head of a pin, and are situated, for the most part, in the retrotarsal folds—chiefly the upper. They are also found scattered throughout the conjunctival membrane.

At first, lacrymation is usually marked, but, later, considerable discharge appears, and superficial ulcers form at the limbus.

After several weeks the disease gradually subsides, usually leaving some cicatrices in the lids to indicate its presence, although in other cases, after the absorption of the granulations, the mucous membrane may be quite smooth.

If the inflammation be but slight and not sufficient to absorb the granulations, the process may run into the chronic form.

Chronic granular conjunctivitis is usually primary, but it may be due at times to the imperfect disappearance of the acute granulations. The constant factor in this variety of trachoma is the trachoma-follicle, as it exists in all of the different degrees in which these conditions are met with.

The development of chronic granular conjunctivitis is often very insidious. Usually, at first, marked lacrymation is present, although there is but little secretion. If the cornea has become vascular, photophobia may be a most distressing symptom. The lids are swelled, and, upon their eversion, the characteristic granulations spring into view. They resemble sago-like prominences arranged in parallel rows, and are found in the superficial layers of the conjunctiva, especially in the fornix. Rarely a few

smaller isolated granules will be seen on the bulbar conjunctiva. At first they are found in the lower *cul-de-sac*, but the upper *cul-de-sac* is soon affected and shows the greatest development of the follicles.

After a few weeks or months the granulations give rise to a more or less active vascular reaction, attended with swelling of the papillæ and a muco-purulent discharge. The papillæ may become so large that they may obscure the granulations. Occasionally the granulations become absorbed, but in the majority of cases fresh eruptions of follicles present themselves during the period of regressive inflammation and go through the same changes as their predecessors.

After a certain duration, grayish lines of fibrous tissue make their appearance, and the final stage of cicatrization begins. As a result of this, dense scar-tissue forms; this exerts traction upon the tarsus—already softened by the pre-existing disease—and produces the deformities of the lids so characteristic of the affection.

Complications.—The corneal complication may take the form of pannus or of ulceration.

Pannus consists in the formation of a vascular tissue of neoformation on the cornea, which begins at the limbus and invades the centre. At the location of the pannus the surface of the cornea is uneven and roughened, and there is a superficial gray and transparent haze, which is infiltrated by numerous vessels; these originate from the blood-vessels of the conjunctiva. The pannus usually begins in the upper part of the cornea and frequently stops below, in a sharp, straight, horizontal border-line. Later, it may develop at other parts of the limbus; so that the entire cornea may become covered. Vision is affected as

soon as the pannus reaches the pupil, which, if the cornea be entirely covered, may be reduced to light-perception.

When ulceration occurs, it is either at the edge of the pannus or upon a portion of the cornea which had hitherto been uninvolved. It usually occasions great photophobia and lacrymation.

The hypertrophy of the conjunctiva increases until the diseased process has run its course, when it begins to shrink, and is replaced by cicatricial tissue, with all its attendant evil consequences to the normal contour and function of the lids. The degree of cicatrization depends upon the severity of the early stages of the disease.

The beginning of the scar-formation shows itself in the tarsal conjunctiva, narrow, whitish lines permeating the latter. These lines become more numerous and form a fine net-work, which gradually spreads; the conjunctiva included within the meshes becomes attenuated, until quite smooth and white.

The hypertrophied conjunctiva in the fornix gradually shrinks, becoming shorter, and the folds of the conjunctiva in that location disappear. This is known as *sympblepharon posterior*. In extreme cases the *cul-de-sacs* are reduced to shallow fissures between the lid and the globe. The lids become distorted, through the cicatricial changes in the cornea and tarsus, the latter participating in the inflammation, as well as the conjunctiva. It becomes much hypertrophied, especially along its lower margin, where the conjunctival vessels perforate it. It is especially in this position that the shrinking of the conjunctiva, which follows later, makes itself most felt, and is the main factor in the production of the bow-like distortion of the lids, produced by trachoma. The cilia no longer occupy their normal position,

but become displaced, and cause great irritation by being brought in contact with the cornea. This irritation is further augmented if the shrinkage of the tarsus continues, and entropion is produced.

Ectropion, of the lower lid especially, may also be originated, due to the contraction of the orbicularis and exerted upon the lids—already prone to eversion by the swelling of the conjunctiva.

Xerosis of the conjunctiva occurs as a result of the cicatrices. The blood-supply to the conjunctiva is shut off and its epithelium undergoes fatty degeneration. The surface of the membrane then becomes dry and smooth and almost leathery, and the corneal epithelium also becomes thicker and its transparency much interfered with. The eye finally becomes blind and a source of continued annoyance, by reason of the constant sensation of local dryness experienced.

The pannus may clear up entirely, leaving a normal cornea beneath. If there be ulceration, however, opacities remain, which disturb vision according to the extent to which they involve the pupillary area of the cornea. Frequently, as a result of pannus, there occurs a connective-tissue metamorphosis, which greatly interferes with the transparency of the cornea. Another result of pannus sometimes is a bulging, or staphylomatous, condition of the cornea, the tissues of which have become so altered that they give way before the normal intra-ocular tension.

Etiology.—In general, the disease may be said to arise from poor hygienic conditions. It develops in institutions where the inmates are crowded together, in armies, orphan-asylums, almshouses, and the like. It is probable that the so-called lymphatic or scrofulous temperament predispose toward it, although the

disease may attack those in perfect health.

Trachoma always arises through infection from another eye already infected, by means of the secretion; only under exceptional circumstances, when the air is heavily charged with the poison, can it be the medium of communication of the disease. The infectious nature of the secretion is doubtless due to micro-organisms; but, while numerous bacteria are found in the secretion, gonococci, streptococci, etc., the specific germ has not yet been isolated.

Etiological factor in acute contagious conjunctivitis a small, unknown bacillus. Weeks (N. Y. Eye and Ear Infirmary Reports, Jan., '95).

It is always contagious,—frequently epidemic. The symptoms, which vary in severity, begin two or three days after infection, with gluing together of the eyelids on awakening in the morning, and small, yellowish masses at the base of the lashes. There is increased lacrymation, congestion, and turbid discharge. It usually begins first in one eye, but affects both in its course. There are burning pains and the sense of a foreign body; the lids are swelled and discolored; and the eyeball is of a rosy tint, which has given the affection the name of "pink-eye." The symptoms continue to increase for two or three days, and frequently a slight coryza arises. Victor Morax and G. W. Beach (Archives of Ophth., vol. xxv, No. 1, '97).

Nine thousand one hundred and sixty-six cases of trachoma (1500 of which were complicated with corneal affections) examined to discover whether there is any accountable pathogenic microbe or not. It was concluded that there is none, but that the morbid entity of trachoma has an histology which is characteristic and absolutely different from that of follicular conjunctivitis. Lessening the alkalinity of the lacrymal secretion tends to the acquisition of conjunctival diseases. V. L. Matkovic (Rec. d'Ophthal., Feb., '98).

Trachoma is due to encapsulated diplococcus, $1\frac{1}{2}$ to 2 millimetres in length

and 5 millimetres in breadth, which is not decolorized by the Gram method of staining, and whose septum at times has an affinity for aniline stains, causing the diplococcus to simulate bacillus. This organism is constantly present in the trachoma-follicle and secretions, before astringent and antiseptic remedies have been employed. E. F. Syndecker (*Jour. Med. and Surg.*, Apr., '99).

A thorough inspection of 36 public schools in New York in July of last year showed that, of 57,450 children examined, 6690 were found to have some form of contagious eye disease. Of these, 2328 were severe trachoma, 3243 were mild trachoma, and 1099 acute purulent conjunctivitis. A large number of cases were excluded from the schools, and there was a coincident increase in the number of trachoma cases treated in the New York eye hospitals. The question of the contagiousness of trachoma is still unsettled. It is probable that children suffering from eye diseases of this class should be excluded from the schools until the condition has been cured. Lambert (*Med. Record*, Feb. 21, 1903).

As the secretion alone causes the infection, therefore, the danger of infection depends upon the strength of the secretion; the richer this is, the greater will the danger be to surrounding persons.

The transfer of secretion from one eye to another is usually accomplished by the fingers or toilet articles which are brought into contact with the eyes, as handkerchiefs, towels, sponges, etc. This is more apt to happen when numbers are crowded together and are likely to use these articles in common.

Pathology.—In trachoma we see an excessive degree of development of the papillæ of the mucous membrane and the formation of the granulations. Microscopically, the granulations may have an imperfect capsule or may have no capsule, but they seem to grow from, or in,

the stroma of the conjunctiva. In the acute form the granulations consist of lymph-cells alone. They are to be regarded as new growths in the conjunctiva, and, in addition to the lymphoid cells, the mass of cells and connective tissue is penetrated by blood-vessels. The chronic granulations consist of lymph-cells toward the surface, but their bases are formed chiefly of connective tissue. Gradually the cellular elements are transformed into connective tissue, and in this way cicatricial degeneration of the conjunctiva is brought about at each spot where a granulation was seated.

The development of the papillæ is not characteristic of trachoma, for it is present in moderate degree in every lasting inflammation of the conjunctiva, as in chronic catarrh, vernal and follicular catarrh, and purulent conjunctivitis.

Prognosis.—Acute granular conjunctivitis, or trachoma, is characterized by its chronicity and by the serious consequences to vision; this, added to its contagiousness, makes it one of the most dreaded of eye diseases. Relapses occur frequently and persistently and may occasion all of the intense inflammatory symptoms of acute granulations. Its great danger lies in its contagiousness and the great rapidity with which it spreads through schools or any institutions where large numbers of inmates are gathered together, by the careless use of towels and common utensils. The prognosis is, therefore, always grave, and demands the adoption of great precautions to prevent a disastrous epidemic.

Treatment.—Prophylaxis is obviously of the greatest importance, and, as the conspicuously-dangerous element is the secretion, cleanliness, adequate air-space, and proper ventilation of the sleeping-rooms must be insisted upon in all

crowded institutions. Every patient should be provided with his own basin and towel, or, better still, should be required to wash under "running water." When the disease is once established, rigorous isolation of all those afflicted should be practiced.

The chief aim of the treatment must be to check the development of the hypertrophy of the conjunctiva, and bring about absorption of the granulations in order to prevent the destruction of the mucous membrane, and to reduce the previous results of the disease to a minimum.

In the early stages, frequent washings of the conjunctiva with a 10-grain solution of boric acid and bichloride solutions should be employed; especially is this true of acute granulations. If there be much pain and photophobia and some haze of the cornea, atropine should be instilled in conjunction with the cleansing lotions. A nitrate-of-silver solution should be employed so soon as the discharge becomes marked, in the same manner and to meet the same indications as already described in the treatment of other forms of conjunctivitis.

Perfect rest indicated for trachomatous eyes. Instillations of atropine, together with use of bandages or cataract shields during the day, are of value. Before bandaging a weak iodoform ointment may be applied to conjunctivæ and lids. At night the protection should be removed and the patient kept in the dark. Properly-fitting glasses should be used when the eyes are not at rest. Massage practiced every week or so by rubbing the granulations lightly with a strabismus-hook. N. B. Jenkins (N. Y. Med. Jour., May 19, 1900).

The treatment of chronic granular conjunctivitis in the early stages must be non-irritating; but, so soon as the discharge becomes marked, silver nitrate becomes the sovereign remedy. When

the acute stage has moderated and the discharge is less marked, the silver salt should be replaced by other caustics: copper, alum, zinc, etc. These drugs must be continued months and perhaps even years, until every trace of hypertrophy has gone and the conjunctiva has become perfectly smooth and clean.

The nitrate-of-silver solution should be applied but once daily, and at times when there are marked signs of irritation, must be wholly withdrawn for a few days, while these are combated with atropine and milder antiseptics.

The prognosis is quite favorable. It should be treated by applications of nitrate of silver of the strength of 1 to 40 or 1 to 50, weaker solutions being less effective. The bacilli found were devoid of movement. Inoculation of a culture on the human conjunctiva produced a typical attack. Victor Morax and G. W. Beach (Arch. of Ophthal., vol. xxv, No. 1).

As it is necessary that the local treatment shall be continued for such a long time during the stage of cicatrization, to prevent relapses, an ointment of 1 grain of tannin to 1 drachm of vaselin may be ordered and may be applied by the patient himself. Copper may be applied in the same strength.

Instillation of 1- to 2-per-cent. solution of creolin recommended in trachoma. E. Nesse (Centralb. f. prakt. Augenh., Mar., '98).

In trachoma during the early vascular stages the lids should be penciled three times a week with the following: Ichthyol, 50 grains; distilled water, 40 grains; glycerin, 10 grains; to be discontinued as soon as the vascularity has subsided. Eberson (Centralb. f. prakt. Augenh., Apr., '98).

After an experience with 3000 cases of trachoma the medicinal management of trachoma is advocated, surgery being reserved for those cases (probably 40 per cent.) rebellious to medicines. H. Kuhnt (Klin. Monats. f. Augenh., Mar., '98).

In trachoma iodine dissolved in a petroleum preparation, as recommended by Nesnamoff, is of value. Slight cases of granular lids may be cured in two or three weeks, while severe cases may require as many months, but the pannus begins to improve markedly in the first week or two. For mild cases the 1-per-cent. solution is applied every other day; in more severe cases a 2-per-cent. solution. H. H. Seabrook (N. Y. Eye and Ear Infirmary Reports, Jan., 1900).

The writer pointed out some years ago that the essentials of any treatment likely to prove effective were fairly well afforded by ichthyol. These essentials he laid down thus: The application must constrict the dilated vessels, remove the infiltration and thickening of the conjunctiva, and alleviate the various subjective symptoms, particularly the pain, the lachrymation, and the photophobia. He found that ichthyolate of ammonia, in 50-per-cent. solution, met these requirements better than any other application he had yet employed. Jacovides also, and Darier, have spoken highly of ichthyol in trachoma. The latter used it undiluted; but this does not seem to be a wise example to follow. The former employed the drug in a great number of different affections of conjunctiva and cornea, and found that its action on the pannus of trachoma was specially marked and beneficial. Denti, too, used ichthyol in trachoma. In his experience the acuter forms were much more favorably influenced by it than the more chronic; its action was specially valuable in cases showing superficial ulceration along with pannus. Bialetti speaks strongly in favor of a lotion of ichthyol (50 per cent.) painted on the everted upper lid and then washed off with distilled water. The first effect of application is a slight burning sensation, which quickly passes off, and is succeeded by relief from photophobia, blepharospasm, and pain, and this relief is not merely transitory. The vessels of the pannus shrivel up under its use, and the corneal opacity clears. Ebersson (Clin. Ocul., Palermo, June, 1901; Edinburgh Med. Jour., June, 1902).

Numerous surgical procedures have been proposed for the excision of the granulations, and some observers advise the excision of the entire fornix of the conjunctiva. It is probable, however, that the resultant cicatrices cause more mischief than those which would result if the disease were allowed to take its course. This form of treatment has, therefore, met with but little favor from the more conservative clinicians.

A less harmful method, and one which is frequently employed by the ophthalmologists of this country at least, consists in the expression of the granulations by means of forceps. Knapp has devised a roller-forceps especially for this purpose. The reaction following this procedure is at times quite severe; so that it is advisable to employ ice-compresses for some time afterward; to prevent a recurrence of the granulations it is always well to follow the expression by applications of silver nitrate.

The amount of benefit obtained from the expression method is, in general, proportioned to the quantity of exudate in and beneath the conjunctiva; where there had been a considerable amount of exudation, the cure is immediate and apparently permanent. Jackson (Med. and Surg. Reporter, Aug. 20, '92).

(a) In the first stage of trachoma the most efficient mode of surgical interference is that of expression, combined with superficial scarification and the introduction of a germicide by the use of a brush. (b) In the second stage, where surgical interference is advisable, the treatment known as "grattage" should be combined with expression in some cases. Canthotomy or canthoplasty, if necessary, gives the most satisfactory results. (c) The operations, as above advised, convert a contagious into a non-contagious condition, and the patient may be admitted to wards for ordinary surgical cases without fear of infection. Weeks (Jour. Amer. Med. Assoc., Sept. 3, '92).

The procedure of Darier and Abadie

used in seventy-five cases; but one grave complication resulting from its use witnessed: a case of total symblepharon due to neglect in the dressing. If a radical cure of the disease could be obtained by this method of treatment, the pain and great local reaction following the operation might be atoned for, but a single instance of permanent cure was never seen. Trousseau (*Archives d'Ophthalm.*, Apr., '93).

Conclusion from the results obtained by the treatment of two hundred cases: Rapid, perfect, and permanent recovery by expression alone, or expression followed by mild caustic treatment, takes place in the majority of cases, especially of the purely follicular type. Imperfect recovery—*i.e.*, disappearance of trachoma, leaving more or less shrinkage of the conjunctiva—results, as a rule, in old neglected cases of inflammatory trachoma. Relapses that are cured by a second or third operation occur in both the simple and inflammatory forms. The operation itself has never injured an eye. Knapp (*Archives of Ophthalm.*, Jan., '93).

Knapp's roller-forceps the most expeditious and surest method of treatment, particularly applicable where the fornix and palpebral conjunctiva are covered with large follicles. Gepner (*Centralb. f. prakt. Augenheilk.*, Oct., '92).

Study of 161 cases of trachoma; expression-treatment as practiced with Knapp's roller-forceps favored. U. Hellgren (*Mittheil. a. d. Augen. d. Carolin. med.-chir. Inst.*, Stockholm, '98).

The greatest emphasis must be laid upon the necessity of placing the subjects under the best hygienic conditions. In the case of patients confined to hospitals, asylums, etc., the utmost pains should be taken to secure good ventilation, nourishing food, and perfect cleanliness, personal as well as general.

When pannus has occurred and the thickening of the conjunctiva subsides, the corneal disease will usually abate *pari passu*; so that the treatment of pannus and of ulcers of the cornea resolves itself into that of the conjunctiva.

Atropine should be instilled to combat any existing iritis.

If the pannus is unusually dense and is partly made up of connective tissue, further absorption may be obtained by exciting a violent inflammation of the conjunctiva. An infusion of jequirity is frequently employed for this purpose. This is prepared by steeping the ground jequirity-bean for twenty-four hours in cold water. With this infusion, the conjunctiva of the everted lids is painted thoroughly two or three times daily. A croupo-purulent conjunctivitis is excited and is combated in the same manner as already described under this disease. When the inflammation has run its course, the cornea is frequently found to have regained, in a measure, its former transparency.

Jequirity beneficial in those cases of granular conjunctivitis where there is superficial vascularity of the cornea. Also used the drug with advantage in the fibrous condition which often follows. Emerson (*N. Y. Med. Jour.*, Feb. 11, '93).

Pannus successfully treated with antipyrine. As the insufflations are painful, cocaine should be used at first, and application made daily or every third day, according to the gravity of the case and the effect desired. The violent reaction that follows should be treated by frequently-changed, hot, antiseptic compresses. This method is not applicable to symptomatic pannus, in which the primary condition should be first remedied. Vignes (*Recueil d'Ophthalm.*, Aug., '92).

The operations of peritomy, which consists in the destruction of the vessels supplying the pannus, has also been much vaunted for the cure of this condition. After a ring of conjunctival tissue about five millimetres from the margin of the cornea is excised by scissors, the underlying connective tissue is dissected off the sclera, which is then laid bare.

Xerosis admits of palliation only by

emollients—such as glycerin, olive-oil, or vaselin—applied freely several times daily.

The distortion of the lids, with the resultant trichiasis and entropion and ectropion which it occasions, only yields to operative measures.

Phlyctenular Conjunctivitis (Lymphatic, or Strumous, Conjunctivitis).

Definition.—Phlyctenular conjunctivitis is a frequent form of inflammation of the conjunctiva characterized by the eruption of one or more grayish elevations or phlyctenulæ on the bulbar conjunctiva. It usually occurs in scrofulous children under ten years of age.

Symptoms.—Children suffering from this disease have the characteristic strumous appearance. They are either pale and thin or bloated and flabby. The cervical lymphatics are enlarged and the nose and upper lip tumefied. There is a moist, eczematous eruption on the face and constant watering of the eyes and nose. Otorrhœa is frequent. A distressing symptom—intense fear of light and blepharospasm, due to the corneal involvement, which occurs in most cases of phlyctenular conjunctivitis—completes a clinical picture which renders an examination of the eyes almost superfluous.

An inspection of the eye, however, will reveal the presence of phlyctenulæ. These appear as minute red eminences, either alone or in numbers. In the latter case they are situated on the limbus of the conjunctiva and resemble grains of fine sand.

In the simple, or solitary, variety the injection of the blood-vessels is localized immediately around each phlyctenule; but in the multiple, or miliary, variety the conjunctival injection is general and is usually quite marked. In the latter variety there is also much photophobia

and lachrymation and rarely some discharge. Usually there is an eruption of these phlyctenulæ on the cornea as well. This is always accompanied by an increase in the photophobia and lachrymation and adds greatly to the gravity of the disease.

Etiology.—Phlyctenular conjunctivitis occurs chiefly among the poorer classes, and is fostered by the improper and insufficient nourishment which they receive and by their damp and unhygienic surroundings. It may be found, however, in children, otherwise healthy, whose vitality has been depressed by febrile disturbances, such as measles, whooping-cough, scarlet fever, and the like. The disease rarely occurs in adults, and only when a tendency toward this disease was manifested in youth.

Emphasis upon the relationship existing between phlyctenular diseases of the cornea and conjunctivitis and general malnutrition. Wallace (University Med. Mag., Apr., '92).

Scrofula is the causative factor in 95 per cent. of all phlyctenular diseases of the conjunctiva. Baas (Woch. f. Therap. u. Hyg. d. Auges., Sept. 29, '98).

Strumous diathesis present in 90 per cent. of 200 cases of phlyctenular conjunctivitis. It is a most important and perhaps a necessary factor. Phlyctenules are, however, not a local tuberculous process, since animals cannot be inoculated with tubercle for them. Axenfeld ("Bericht über die xxvi Versammlung der Ophthal. Gesellschs. zu Heidelberg"; Med. and Surg. Reviews of Reviews, Dec., '98).

Pathology.—A phlyctenule consists of an accumulation of lymphoid cells packed closely together around a nerve-filament, just beneath the epithelium of the conjunctiva or cornea. Soon after its formation the apex of the mass begins to undergo softening and liquefaction. The epithelial covering is thrown off and a shallow ulcer remains. The

softening process continues, the epithelium dips down into the ulcer, and healing is accomplished in ten to fourteen days.

After a time, however, a fresh outbreak of these small grayish nodules occurs; so that the disease may extend over months and at times years, until the age of puberty is attained, when the eye seems to become protected against further attacks.

In consequence of the corneal involvement, which is usually associated with phlyctenular conjunctivitis, there is always a greater or less degree of cloudiness of that membrane; so that vision is interfered with and the patient rendered incapable of fine work. Again, the scars left upon the cornea are often most unsightly.

Treatment.—This must be directed, in the first place, toward the improvement of the general condition. Notwithstanding the photophobia, open-air exercise should be positively enjoined, as it is absolutely essential for the well-being of the child. All bandages should be removed, the eyes being protected by tinted glasses or a generous shade. The skin should be rendered more active by cold or salt baths, followed by brisk rubbing. The nourishment should be strengthening and administered at regular intervals. No feeding should be permitted between meals; all sweets and pastry should be prohibited, while milk, fresh eggs, red meat (once daily), and proper fruits should represent the bulk of the diet recommended.

Internally, calomel is of value to improve the state of the mucous membrane of the alimentary tract; codliver-oil, syrup of the iodide of iron, syrup of the phosphate of lime, and arsenic may also be administered with advantage.

If seen in the early stages, it is advisable to avoid all external irritants by the use of smoked glasses. Gorecki (*Le Praticien*, May 20, '90).

Locally, any existing blepharitis or eczematous eruption about the eye should be combated with white-precipitate ointment (1 to 2 per cent.) and with silver nitrate, after the removal of all crusts with a simple soda solution.

In the simple form, where there is but little irritation, calomel should be dusted into the eye once daily. This drug combines with the tears, and forms a weak solution of bichloride of mercury, which exerts a most beneficial action upon the conjunctiva. Care, however, must be observed that iodine is not being administered internally at the same time with the calomel, for the latter in this event forms with the iodine an iodide of mercury which is very irritating to the eye.

A salve of the yellow oxide of mercury may be substituted for the calomel in many cases with great advantage.

In the miliary variety, or when there is recent corneal involvement with signs of active irritation, these drugs, which are irritating, should not be applied. In these cases the eyes should be kept clean with frequent washings with boric acid, and atropine should be instilled at regular intervals.

The photophobia and blepharospasm usually subside with the improvement in the conjunctival condition. Should it be very distressing, however, much relief may be had by cold baths or from immersions of the child's head in a basin of cold water.

Croupous Conjunctivitis.

Definition.—Croupous conjunctivitis is a catarrhal inflammation of the conjunctiva in which, owing to the intensity of the inflammation, there is formation

of a plastic exudate upon the conjunctival surfaces.

Symptoms.—It usually begins with the symptoms of an acute catarrh, but soon attains a severity not witnessed in ordinary catarrh. The lids become oedematous, the conjunctiva much reddened and swelled, especially in the fornix, and a discharge, at first sero-purulent but later muco-purulent, appears. The tarsal mucous membrane and retrotarsal folds become covered with a grayish-white membrane, the bulbar conjunctiva being but rarely involved. The pseudomembrane can be stripped off, disclosing a raw and perhaps bleeding mucous surface beneath, which serves to distinguish it from the diphtheritic variety.

The pseudomembrane usually disappears after two weeks; the conjunctiva and lids reassume their normal appearance and the signs of an ordinary catarrhal conjunctivitis reappear. There are no resultant cicatrices and vision is but seldom affected, the cornea being only involved when the false membrane spreads to the bulbar conjunctiva, which is of rare occurrence.

Case of recurrent membranous conjunctivitis in which the membrane had been removed several times, but always recurred; it had the appearance of a superficial burn. Batten (*Ophthalmic Rev.*, Dec., '97).

Diagnosis.—The main affections from which croupous conjunctivitis are to be differentiated are diphtheritic conjunctivitis and ophthalmia neonatorum.

DIPHTHERITIC CONJUNCTIVITIS.—Instead of being limited to the surface of the conjunctiva, the membrane in diphtheritic conjunctivitis involves its deeper layers. The lids are hard and the bulbar conjunctiva is involved, and there is frequent corneal ulceration.

There is no reason not to consider as diphtheritic a case of conjunctivitis pre-

sented by false membrane. This form of conjunctivitis can present a more or less grave diphtheritic character, and a relative benignity should not authorize the exclusion of this disease from the diagnosis. In cases of conjunctivitis showing the formation of false membrane the treatment should be most active. The detection of the microbe is the only method of making a sure diagnosis, and the general system may become infected from the local *nidus*. Fernandez (*Cronica Médico-quirúrgica de la Habana*, No. 11, '92).

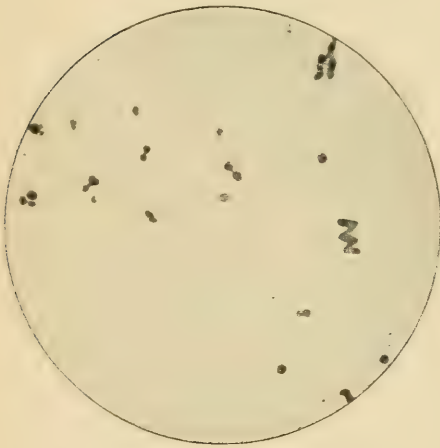
The diagnosis of diphtheritic conjunctivitis must rest upon the presence of pure diphtheria bacilli. There are whitish conjunctival patches containing dusky hæmorrhages, enlargement of pre-auricular glands, coincident diphtheria of the fauces, and subsequent loss of knee-jerks, or the occurrence of paresis or paralysis. S. Stephenson (*Brit. Med. Jour.*, June 18, '98).

OPHTHALMIA NEONATORUM.—In this disease, purulent conjunctivitis, the discharge is much more copious and purulent. Pseudomembranous conjunctivitis is never found among the newborn.

Pathology.—The local inflammation must be regarded as a severe form of catarrh only, in which, owing to the intensity of the inflammatory process, the secretion is richer in fibrin and more prone to coagulation. Various grades of this plastic quality appear. In light cases it may manifest itself as a simple condensation of the secretion, flakes of fibrin forming, which can be readily washed off of the conjunctiva. In some cases, however, the exudate has the tenacity of a true diphtheritic membrane.

Case of chronic membranous conjunctivitis. A boy, 8 years old, had been under observation for eighteen months, with a thick, firmly-attached, yellowish-white membrane covering the conjunctiva of the upper lid. Treatment had exerted but little influence upon the membrane, although it was then becom-

ing thinner. The eyeball had not been seriously damaged. But at one time in its course there had been a severe exacerbation of the disease in the eye, with soreness of the throat and patches of similar membrane on the tonsils, and rise of temperature. Two children that he came in contact with in the same ward at this time developed diphtheria and died. A sister of this boy had presented a similar chronic membranous conjunctivitis. After it had lasted nearly a year and a half she developed scarlatina with diphtheritic patches in the throat. This



Pathology of chronic membranous conjunctivitis. (Howe.)

was accompanied by aggravation of the eye-symptoms, and necrosis of the cornea, with loss of useful vision in both eyes.

Although both these cases were carefully studied bacteriologically, and many micro-organisms discovered, the Klebs-Loeffler bacillus was present in each case only during the exacerbation, and not at any other time. (See illustration.) Lucien Howe (Trans. Amer. Ophth. Soc., '97).

In making a positive diagnosis of diphtheritic conjunctivitis the microscope does not aid very much. The xerosis bacillus gives exactly the same reaction to the stain that the Klebs-Loeffler bacillus does; it looks the same under the microscope, and without clinical symptoms is of no significance whatever. The one fact which settles the diagnosis

is the inoculation of rabbits or guinea-pigs, because there is no reaction to the xerosis bacillus and there is to the diphtheria bacillus. Pinckard (Ophthalmic Record, Aug., '99).

Ophthalmia from infection with the diphtheria bacillus is not rare in London. At the Northeastern Hospital for Children about 2 per cent. of all cases are of this nature. Stephenson (Lancet, Feb. 17, 1900).

Etiology.—Croupous conjunctivitis is a disease of childhood, and usually develops at first dentition. Its causal factors are the same as those of catarrh, but certain pyrexias, particularly measles and pseudomembranous vulvitis, predispose to it. It may be associated with croup of the larynx, trachea, and bronchial tubes.

Treatment.—Hot-water compresses should be applied night and day until the pseudomembrane is removed. The general health should be seen to, and purgatives administered to produce watery evacuations. All caustics and irritants should be avoided so long as the pseudomembrane is present, but the eye should frequently be washed with bichloride-of-mercury (1 to 5000), boric-acid, chlorate-of-potash, or chloride-of-sodium lotions. As soon as the stage of acute catarrh sets in, the treatment should be the same as in acute conjunctivitis.

Instances of croupous conjunctivitis that was complicated by disease of the entire cornea, an abscess involving the lower half of this latter membrane. The usual treatment failing to arrest the progress of the disease, a dressing of aristol was applied. This was followed in a short time by the most favorable results. Eliasberg (Archives d'Ophthal., Feb., '93).

Irritating remedies, especially silver nitrate, harmful in pseudomembranous conjunctivitis. Valude (Archives d'Ophthal., Oct., '94).

Case of pseudomembranous conjunctivitis in newborn child, due to streptococcus, treated by Roux's serum; total loss of both cornæ. Darier (*Annales d'Oculistique*, June, '95).

Diphtheritic Conjunctivitis.

Definition.—Diphtheritic conjunctivitis is an infrequent specific inflammation of the conjunctiva, attended by the formation of a plastic exudate within the layers of the bulbar and tarsal membrane.

Symptoms.—The exudation penetrates deeply into the tissue and causes its death, thereby destroying the nutrition of the cornea and causing subsequent loss of that membrane. The lids become hard, board-like, and tumefied. At first there is a scanty sero-purulent or sanious discharge, which is followed by a more purulent one as the disease progresses. The secretion is very contagious, and, if there be abrasions at the orifices of the mouth and nose, the membrane will quickly invade them. Patches of membrane are often found in the pharynx and nares.

After the period of infiltration—which lasts from one to two weeks—has subsided, the membrane is thrown off, leaving a raw, granulated surface. At times the membrane may be absorbed. After a time vascularization sets in and the symptoms of an ordinary purulent conjunctivitis supervene. The termination of the process, however, is less favorable than in the catarrhal form, for during the period of cicatrization changes occur which cause atrophy and shrinking of the conjunctiva, and not infrequently occasions great deformation of the lids.

Complications.—The chief complication is corneal involvement, which occurs in the vast majority of the cases, and occasions the intense pain by which the disease is accompanied. As a rule, the cornea is affected early in the af-

fection, either by ulceration or diffuse infiltration.

Etiology.—The disease is of specific origin, and the constant presence of Löffler's bacillus has lead to the assumption of this germ being the causal factor in the diphtheritic process.

Children between the ages of two and eight years are usually affected, both eyes being involved. The disease is rare in this country, but is not infrequent abroad, where it occurs in an epidemic form. The prognosis is decidedly grave on account of the tendency toward corneal involvement.

Treatment.—In the first stage, when the lids are hard and board-like, and there is a necessity of limiting the amount of exudation, ice-compresses should be employed, but hot compresses are indicated as soon as the cornea shows signs of involvement. Treatment must be tentative. Mild antiseptic lotions should be employed to remove all secretions, either bichloride of mercury (1 to 8000) or potassium permanganate in 2-per-cent. solution. Silver nitrate is contra-indicated in the early stages, but may be utilized when the membrane comes away. Atropine should be instilled early on account of the tendency to corneal involvement. Great attention should be directed toward building up the general health. Mercury and quinine should be administered and stimulants ordered if the child shows signs of collapse. The isolation of the patients is necessary to prevent further contagion.

Treatment by antitoxin of 25 cases of diphtheritic conjunctivitis occurring among 8000 cases of diphtheria at the Boston City Hospital. In all these cases the Klebs-Löffler bacillus was present in the discharges from the nose. Eight cases were admitted for ocular diphtheria; the others were faucial diphtheria which had incidentally a mem-

brane on the conjunctiva. All were treated with antitoxin, the first dose being 4000 units. Usually a second dose of like amount was given at the end of six or eight hours, and some had three or four injections. Such cases in twenty-four hours usually were doing well, and after forty-eight hours no more anxiety was felt for the eyes. In those cases in which there were corneal ulceration the antitoxin favorably affected the corneal lesion, and with the exception of 4 cases the patients left the hospital with good vision. In 1 of these 4 cases the cornea upon admission seemed to be wholly necrotic. Six months later there was considerable vision. An opaque scar occupied approximately half the cornea. In the 3 other cases every cornea was lost. These 3 patients had diphtheritic infection during an attack of measles. This probably accounted for the severity of the corneal process. M. Standish (Boston Med. and Surg. Jour., Oct. 2, 1902).

Tubercular Disease of the Conjunctiva.

Symptoms.—Tubercular disease of the conjunctiva may be either present itself as a primary or a secondary manifestation; in either event it is an extremely rare disease. In both varieties the disease occurs in the form of small, yellowish-gray nodules on the palpebral conjunctiva. These break down and form ulcers with uneven and indurated edges. The floors of these ulcers have either a lardaceous appearance or are covered with grayish-red granulations. The conjunctiva is swelled and turgid, the lids are thickened, and there is considerable discharge. The bulbar conjunctiva and the cornea may become affected, and in severe cases the ulcers on the palpebral conjunctiva may burrow down and involve the entire thickness of the lid. Although this gives a clinical picture which is almost characteristic, the diagnosis may be verified by the discovery of the tubercle bacillus in the contents of the ulcers.

Case of tubercle of the conjunctiva in a boy 15 years of age. The condition resembled that of trachoma; the membrane was greatly shrunken and the eyeball was atrophic. Microscopical study showed giant-cells, but no bacilli. Roberts (Brit. Med. Jour., June 10, '93).

Conjunctival tuberculosis may closely simulate trachoma. In one case a microscopical examination of a piece of the conjunctiva was necessary before an exact diagnosis could be made. H. Heinersdorff (Klin. Monats. f. Augenh., Mar., '98).

The disease usually affects but one eye and occurs almost without exception in the young. It manifests a great tendency to recur, and may become the starting-point of general tuberculosis.

Etiology.—As a rule, tubercular conjunctivitis is a primary disease and originates in a direct infection of the conjunctiva. When the disease occurs as a secondary manifestation, it is usually transmitted from the nasal or pharyngeal mucous membrane by means of the lacrymal passages.

Treatment.—This should consist in the removal of all the diseased structure if the process be localized, by the curette, knife, or galvanocautery; but, if the involvement of the ocular structure be disseminated, enucleation should be instantly performed.

Case of undoubted primary tuberculosis of the palpebral conjunctiva, verified by the finding of a few Koch bacilli. The eye in other respects remained uninvolved. The palpebral ulceration was treated and cured by frequent application of silver nitrate, bathing with saturated solution of potassium chlorate, and curettage. The patient died, two years later, from laryngeal and pulmonary phthisis. H. Armaignac (Ann. d'Oculist., Aug., '97).

Lupus of the Conjunctiva.

Conjunctival ulcers occurring in this disease are distinguishable from tubercular ulcers chiefly by the fact that they

have involved the conjunctiva from the skin, instead of from the mucous membrane, and, like cutaneous lupus, they undergo spontaneous healing in one place, while the ulcer keeps advancing in another. The disease occurs either as a primary process or as an extension of the disease from the surrounding skin. It appears as an ulcer, the bottom of which is covered with granulations, which bleed on the slightest touch and are filled with tubercle bacilli.

Treatment consists in thorough removal of the contents of the ulcer with a curette, followed by careful cauterization.

Pemphigus.

Pemphigus of the conjunctiva is a very rare affection, and is usually seen in connection with pemphigus vulgaris of other parts of the body, although it may occur as an independent disease. Bullæ form upon the conjunctiva and are attended with pain, photophobia, and lacrymation. The blisters break down and form cicatrices in the conjunctiva. Repeated recurrence is the rule, so that the membrane finally becomes much shrunken and atrophied, and appears dry, smooth, and tense. The cornea becomes cloudy and the lids are frequently distorted, aggravating the symptoms by the displacement of the cilia which this occasions.

Treatment is of no avail, though the condition may be mitigated by emollients, and protection from the light and air by coquilles. Arsenic may be administered internally.

Syphilitic Disease of the Conjunctiva.

Chancres about the eye, as a rule, develop on the edge of the lids; they may also be observed on the palpebral conjunctiva and rarely on that of the globe. The disease is usually transmitted by kissing. At times, however, ulcers may

form from the breaking-down of gummata of the conjunctiva.

Instance of a syphilitic ulcer of the bulbar conjunctiva. The initial lesion had occurred eighteen months previously. Under general antisymphilitic measures the local manifestation disappeared promptly. Fromaget (*Gaz. Hebd. des Sciences Méd. de Bordeaux*, Aug. 6, '93).

Case of mucous patch of the conjunctiva complicated by a pseudomembranous formation in a woman, 20 years of age, who exhibited other secondary lesions of syphilis. The conjunctiva of the lower eyelid was swelled and congested and covered by a pseudomembranous exudate. Schwartzschild (*Med. Rec.*, Apr. 22, '93).

Tumors of the Conjunctiva.

Tumors of the conjunctiva may be both malignant and benign.

DERMOID.—The most common among the latter is the dermoid, which is always congenital and is often found associated with wart-like growths from the skin in front of the ears, and with harelip. They are ascribed to an arrest of development. They occur as pale-yellow rounded or oval bodies the size of a split pea, usually at the extreme limbus of the cornea. Their surface is dry and smooth and frequently has a few hairs projecting from it.

If, as sometimes happens, the growth shows a tendency to involve the cornea or cause irritation, it should be excised, care being taken to avoid injuring the deeper layers of the cornea.

POLYP is a benign pediculated growth of the conjunctiva, which is but rarely seen. It is usually very small and is found in conjunction with the caruncle.

PAPILLOMATA are occasionally confounded with polypi, but may be readily distinguished from them by their rough, raspberry-like surface. They may be pediculated or sessile. Both forms of growths may be readily removed with scissors.

ANGIOMATA are rare, but when they occur are usually found in association with a caruncle. They are congenital, but, as they usually increase in size after birth, their removal is usually demanded.

The conjunctiva is rarely the seat of malignant tumors, but both epithelioma and sarcoma may occur. They both arise from the tissue at the limbus.

EPITHELIOMA of the conjunctiva is non-pigmented, and occurs as a flat, reddish tumor with a broad base. The tumor slowly increases in size, involving the cornea like pannus, and is prone to ulceration.

SARCOMA is usually pigmented and may attain large size, the growth being at times very rapid. They rarely attack the cornea.

The early removal of both of these forms of growth is imperative, to prevent implication of the other structures of the eye. Enucleation is frequently demanded.

Subconjunctival sarcoma removed from a patient 62 years old. Four years later there was not a trace of recurrence or metastasis. K. Joerss (Beit. z. Augenh., Jan., '98).

CRSTS.—Simple cysts of the conjunctiva are very uncommon. They appear as translucent spherical bodies the size of a pea, usually on the bulbar conjunctiva, and may be regarded as dilated lymphatic vessels.

CYSTICERCUS.—Subconjunctival cysticercus is also an extremely rare affection. It may be distinguished from the foregoing by the fact that it may be readily moved under the conjunctiva, while simple cyst cannot, as a rule, be moved from its position. The diagnostic point, however, is the presence of a round, white, opaque spot on the anterior surface of the tumor, the *receptaculum* of the cyst. Excision of the growth by dissection is indicated.

Miscellaneous Disorders of the Conjunctiva.

CONJUNCTIVAL ECCHYMOsis.—This may be originated by traumatisms or violent inflammation of the conjunctiva, or may occur spontaneously in the aged, from brittle blood-vessels, and in children in association with disease attended by spontaneous hæmorrhage elsewhere, particularly after whooping-cough.

The meshes of the conjunctiva become filled with blood and the staining of the tissues may persist for some weeks. When the ecchymosis appears under the conjunctiva several days after an injury to the head, it becomes an important factor in the diagnosis of fracture of some of the bones composing the orbit.

CHEMOSIS.—Chemosis of the conjunctiva results when the connective-tissue layer is filled with serum, usually as the result of a severe inflammation of the conjunctiva or some of the deeper ocular tissues; it may, however, appear spontaneously.

LYMPHANGIECTASIS of the conjunctiva occurs at times as a small collection of blisters on the bulbar conjunctiva, due to distension of the lymph-channels as a result of interference with their circulation. It may occur at any stage and is not significant.

LITHIASIS of the conjunctiva consists in the deposit of chalky matter in the ducts of the Meibomian glands, and gives the appearance of numerous, small, yellowish-white spots scattered throughout the conjunctiva. As they frequently occasion considerable irritation, they should be removed by incision.

AMYLOID DISEASE of the conjunctiva is due to a peculiar degeneration of the conjunctiva in which pale-yellowish masses appear chiefly on the palpebral conjunctiva, but also in the bulbar portion. The lids become much swelled

without the usual attendant signs of inflammation. The conjunctiva resembles white wax.

The disease is primary, although it may also at times be developed from granular conjunctivitis.

Treatment should consist in removing sufficient of the conjunctival masses to permit of greater freedom in the movements of the lids, which are often much restricted, and to gain better vision.

PINGUECULA is a small, yellowish elevation in the bulbar conjunctiva near the corneal limbus and usually situated to the inner side. It is composed of connective tissue and elastic fibres, in association with a colloid substance; it is due to the action of external irritants. It has no significance beyond its cosmetic effect, except that it may originate pterygium.

Pterygium.

Symptoms.—Pterygium consists in a triangular fold of hypertrophied conjunctival and subconjunctival tissue of fleshy appearance, generally situated to the inner side of the cornea in the palpebral fissure. It may, however, be on the outer side of the cornea and in the traumatic variety may entirely surround the membrane. The apex of the triangle or the head of the growth is attached to the cornea, while the base spreads out like a fan into the semilunar fold. The neck of the growth lies between the apex and the base and corresponds to that part which lies on the limbus.

At times the pterygium may push its way across the cornea and disturb vision by involving the pupillary area of that membrane. But usually, however, it shows no tendency to advance into the cornea.

In its early stages the growth is thick and fleshy in appearance; but it becomes paler after a time and its blood-vessels

are reduced to fibrous cords, giving the structure a tendinous appearance.

Pseudopterygium may always be diagnosed from the true variety by the fact that a probe may be passed under the neck of the latter, whereas this procedure is impossible in pseudopterygium, owing to the matting together of the tissues by the preceding inflammation.

Etiology.—Pterygium never occurs in children, although it is not an uncommon disease of adult life. Fuchs thinks that its starting-point is usually a pre-existing pinguecula, and that it is due to the prolonged influences to which the conjunctiva in the region of the palpebral fissure is exposed. It is especially common among persons who are submitted to the inclemencies of the weather: sailors, coachmen, farmers, and others.

Pseudopterygium, or traumatic pterygium, occurs as a result of some inflammatory process which causes a lesion of the margin of the cornea. This variety is especially liable to form after burns or marginal ulceration occurring in purulent conjunctivitis or phlyctenular disease.

Treatment.—If the pterygium be small and shows no tendency to involve the cornea, it should be allowed to remain, for its removal for cosmetic purposes will be unsatisfactory, owing to the scar which remains upon the cornea and conjunctiva.

A pterygium may be removed either by excision or by ligature. In the former method the head of the growth is grasped with fixation-forceps and is dissected off from the cornea by a sharp knife. This being accomplished, the growth should be separated from its base by two converging incisions. After the removal of the pterygium, the edge of the wound should be carefully united by

sutures. If the growth be very large, it may be split into an upper and lower half after its dissection from the cornea, and the flaps thus obtained transplanted into the superior and inferior *cul-de-sacs*.

Electrolysis is of value in the early stages of pterygium, in a strength of 3 milliamperes, the needle (connected with the positive pole) being inserted at right angles to the axis of the growth. H. M. Starkey (Jour. Amer. Med. Assoc., Sept. 17, '98).

A simple procedure in the treatment of pterygium described by A. Coe is cauterization of the head of the membrane by means of a platinum wire, with a fine bulbar end, not larger than a very small pea, and heated in an alcohol-lamp. Practically complete cure obtained in an extensive pterygium by three cauterizations of this kind, carried out at intervals of a few days. At the end of several months it was possible to make out only a light opacity, corresponding with the thickening in the conjunctiva, while the nearer tissues were entirely transparent. The same treatment in 24 cases, with invariably good results, excepting in one patient, who presented a very extensive pterygium with large vascularities. F. B. Loring (Semaine Méd., No. 34, 1902).

Injuries of the Conjunctiva.

FOREIGN BODIES.—Small-sized foreign bodies frequently make their way into the conjunctival sac and cause considerable pain by the pressure which they exert upon the cornea with every movement of the lid. If the body be found imbedded in the lower *cul-de-sac*, it is an easy matter to remove it, but if it be under the upper lid, it is necessary to evert the latter. This is accomplished by grasping the lashes and the edge of the lid with the thumb and forefinger of the right hand while the patient is directed to remain looking down, slightly pressing upon the upper edge of the tarsus either with a finger of the other

hand or some convenient instrument: a blunt pencil, a probe, etc.

Large bodies may remain buried deep in the *cul-de-sacs* for weeks at a time, and merely cause the symptoms of a chronic catarrhal conjunctivitis. Of this nature is the inflammation set up by the "eye-stones" which are frequently introduced into the eye by laymen to remove cinders or other foreign bodies. Having performed their function, they become imbedded in the folds of the conjunctiva.

WOUNDS.—The conjunctiva is not infrequently involved in wounds of the globe itself or of its adnexa. If the wound be extensive, the edges should be approximated with stitches, but otherwise a simple boric-acid wash with a protective bandage will suffice.

BURNS.—Burns of the conjunctiva are common. These are usually caused by lime, acids, hot water, hot ashes, molten metal; etc., and are particularly serious on account of the subsequent contractions and deformities which they occasion in the lids and damage wrought in the cornea.

If the substance inflicting the burn is lime, the eye should be washed with a diluted or weak solution of a mineral acid, or, if this be not at hand, all particles should be removed at once by forcibly flooding the eye with water from a hose or spigot.

If an acid has caused the burn, it should be neutralized by a weak solution of borax, bicarbonate of soda, or of common salt if nothing else be on hand.

Subsequent inflammation is best combated by cold compresses, boric acid, atropine, and some emollient substance, such as vaselin.

WM. CAMPBELL POSEY,

Philadelphia.

CONSTIPATION. — Lat., *constipatis* (from *constipare*, to pack together).

Definition.—Prolonged retention of fæces in the alimentary canal; retarded defecation; a symptom resulting from a variety of morbid conditions of the intestines, and not a distinct disease. The strictly-natural law governing intestinal evacuations in man requires one, and sometimes two, discharges every twenty-four hours.

Symptoms.—The symptoms produced by habitual constipation vary much in different cases. Many persons appear to enjoy fair health with an evacuation only once in two or three days. A smaller number continue well with only an evacuation once a week; one woman came under my observation who claimed to have had no fæcal discharge from the bowels for thirty days, and yet had been attending to her household duties all the time, with only a sense of fullness in the abdomen and some dizziness in her head.

Case of Hindoo male, aged 50 years, 5 feet 6 inches high, who has been, since his 30th year, in the habit of passing stools once in six months or so, and even then only two or three hard scybala are passed. But every eight months the man gets a severe attack of fever, preceded by rigors, and then he passes, to his entire relief, sometimes consciously and at others in an unconscious state, enormous quantities of black, semisolid, feculent matter, which has evidently been accumulating in his intestines all the while. Notwithstanding all this, the man looks well and healthy. He suffers very little from this except a slight loss of appetite and energy. His abdomen is not bloated, but feels hard on pressure. He does not complain of flatulence; passes urine freely; and sleeps well. S. Kotayya Naidie (Indian Med. Rep., May 1, '96).

In a large majority of persons, however, constipation causes a sense of fullness, lassitude, mental depression, or dull pain in the head, with some impairment

of digestion, all of which symptoms are temporarily removed by a free movement of the bowels. In some cases after retention of the intestinal contents from three to five days, a spontaneous diarrhoea supervenes for a single day, after which the constipation returns as before. In many other cases, protracted constipation leads to a violent attack of headache every week or ten days, accompanied by extreme nausea or vomiting for a day, during which the bowels are evacuated, and the next day the patient returns to his ordinary duties, though pale and impaired in strength.

Most of the dyspeptic conditions, dilation of the stomach, etc., are really cases of constipation, and this may mechanically tend to produce hæmorrhoids, hernias, vesico-uterine tumors, hypertrophy of the prostate, etc. Germain Sée (Med. Rec., Feb. 3, '94).

Hysteria in the female and hypochondria in the male, or even conditions bordering on insanity, may be the result of constipation. Staple (Amer. Med.-Surg. Bull., Aug. 15, '94).

In many cases the middle and posterior part of the tongue is covered with a light coat and the urine is deeper color and less in quantity than natural; the appetite is variable. Sometimes the colon is distended with gases, with slight tenderness on pressure and irregular peristaltic movements. In such cases the operation of physic is liable to be accompanied by pains across the abdomen and tenesmus, and some mucus may be evacuated with the fæces. Such symptoms indicate congestion or inflammation in the mucous membrane of the rectum, which is sufficient, in some cases, to cause frequent slimy discharges, while the ascending and transverse colons remain filled with compact fæces.

Many cases of constipation are treated unsatisfactorily with medicine when the real cause is in the rectum. The pres-

ence of thickening of the skin and mucous membrane, irritable ulcer or fissure, fistula, or hæmorrhoids frequently interfere with the treatment instituted. W. M. Beach (*Pittsburgh Med. Rev.*, June, '95).

A narrowing of the ileo-cæcal valve is the cause of certain cases of obstinate constipation. W. J. Mayo (*Annals of Surg.*, Sept., 1900).

Differential Diagnosis.—Simple retention of the fæcal contents of the intestines longer than natural may be considered as sufficient diagnostic evidence of constipation in an unqualified sense. But as undue retentions of fæces are often caused by a variety of mechanical obstructions, such as strictures, invaginations, concretions, morbid growths or tumors, and visceral displacements, all these have, by common consent, been classed as intestinal obstructions, while the words "costiveness" and "constipation" are properly made applicable only to such cases as depend upon failure of one or more of the physiological conditions on which regular intestinal evacuations depend.

Congenital stricture of the anus or rectum is a frequent cause of constipation, the following being two examples: 1. A child, aged 9 months, always subject to constipation, became obstinately so after being weaned. Rectal examination revealed a membranous septum, with a small central perforation. This embryonic relic had allowed the stools to pass fairly well while suckling continued, but as the fæces became more solid, definite symptoms arose. 2. In a baby, a few weeks old, numerous small motions were found to be associated with anal stenosis due to a fold of mucous membrane which barely allowed a catheter to pass. Congenital rectal stenosis is also said to be due to intra-uterine enteritis, which gives rise to great hypertrophy of the walls of the bowel. Filatow (*La Méd. Infantile*, Nov. 15, '97).

Rectal examination is often neglected in infants, and thus the cause may be

missed. In healthy infants the little finger can be introduced into the rectum; if this is impossible, some morbid condition is present. Marfan (*La Méd. Infantile*, Oct. 1, '97).

Differential diagnosis involves, first, proof of the absence of mechanical obstructions, and, second, proof that the physiological conditions concerned in natural evacuations are at fault in any given case. In all cases of intestinal obstruction the pains, distension, and tenderness are uniformly manifested at some one part of the abdomen or pelvis. If the obstruction is from the pressure of tumors or morbid growths these can generally be detected by proper physical examination of the abdomen.

If from stricture or invagination there will be not only well-marked pains and fullness at some one location, but in strictures, especially, the past history of the patients will show them to have been the sequelæ of dysentery, typhoid fever, or some form of primary intestinal ulceration. Obstructions by uterine displacements or rectal concretions are readily detected by direct examinations through the vagina and rectum.

[A result of chronic constipation often seen, which may not only simulate, but also cause uterine trouble, is enlargement and pouching of the lower third of the rectum. This condition is found very frequently in virgins, and gives the pain in the back, discomfort in standing or walking (more particularly in standing), and the sensations of dragging and fullness, as if the parts would fall. This is due to the distension and varicosity of the vaginal and uterine veins, caused by the formation of a proctocèle, pressing the vagina forward. Efforts in defecation then cause intense pain, pressing the vagina and rectum downward to the pubis and perineum; instead of relieving the patient, however, the traction on the vagina forces the uterus downward, and prolapsus or retroversion results. In this condition, the correction

of the retroversion does not relieve the patient, since the cause is not the retroversion, but the rectocele, due to the constipation. The proper course to pursue is to cure the constipation, when the reposition of the uterus will cure the symptoms. CHARLES B. KELSEY, Assoc. Ed., Annual, '92.]

Constipation not caused by mechanical obstruction may result from impairment or suspension of the natural peristaltic motion of the intestines, and from paralysis of the nerves of the rectum concerned in the act of defecation, from irregular contractions of the circular fibres of the muscular coat by which regular peristalsis is prevented, from the reversing influence of continuous nausea, from excessive obesity coupled with loss of tone in the abdominal muscles, and from deficient mucous and glandular secretions, by which the fæces are permitted to become dry and hard. In all these cases a careful manual examination of the abdomen will detect the presence of fæcal accumulations in different parts of the colon and rectum. And their location will vary from day to day, instead of uniformly appearing in the same place, as in cases of obstruction.

Etiology.—Habitual constipation is more frequent in adults than in children, and more frequent in females than in males. Probably the most efficient causes of constipation are sedentary in-door habits with deficient out-door muscular exercise. The first necessarily lessens the efficiency of respiration and internal distribution of oxygen, thereby lessening the tone and activity of the nervous and muscular structures generally; and the omission of the latter still further lessens tissue-metabolism and excretory processes. If we add to the foregoing the depression of the transverse colon and the crowding of the abdominal and pelvic viscera down upon the rectum by well-

known female habits of dress, we will have the chief causes why females suffer much more from constipation than the male sex.

The hæmorrhoidal arteries and veins are closely connected with the portal circulation by the anastomosis between the hæmorrhoidal branch of the inferior mesenteric, which supplies the upper part of the rectum, and the hæmorrhoidal branches of the internal iliac, which supply the lower part; congestion of one circulation means congestion and sluggishness of the other. The rectum, in its descent into the pelvis, goes from the left sacro-iliac synchondrosis to the middle of the sacrum, the ovary and tube on that side being almost in contact with it; a distension of the rectum by fæcal accumulation implies a fixity of the uterus, and a congestion of the pampiniform plexus and congestion of the ovary. To relieve this condition we must not rely on hot douches, iodine, or glycerin applications, but relieve the engorgement of the ovarian veins by the emptying of the rectum. Murray (*Archives of Gynecology*, June, '91).

There is, beyond doubt, a form of habitual constipation in which there is either diminished irritability of the intestinal nerves or defective development in the muscular coat of the intestine; an hereditary factor is often present. It may be acquired through habit of suppressing the desire, insufficient diet, or abundant diet difficult to digest, deficient in water, or too easily absorbed. Sedentary habits are also a cause, but obstinate habitual constipation may occur even in those who lead an active life. Disturbances in the circulation—as in heart disease, mechanical pressure, and particularly pregnancy—may produce it; but displacement of the bowel, such as occurs in Glénard's disease, is of doubtful influence. Adhesion of coils of intestine together, or to some other organ, is an occasional cause. The relation of constipation to mental disturbance is well known, and the theory of intestinal intoxication, also, cannot be set aside. Prognosis, as a rule, is unfavorable. Ewald (*Berl. klin. Woch.*, Mar., '97).

Another very common cause of constipation is the failure to adopt and persistently maintain a regular time for daily defecation.

Instead, many persons frequently resist a desire to evacuate at the regular time from pressure of other engagements, and thus the nerves of the rectum become habituated to the contact of fæces and cease to renew the desire to evacuate except at long intervals.

Constipation generally results from diminished secretion, atonic condition, and relaxation of abdominal muscles dependent on sedentary habits and irregularity in defecation, irrational diet, or excessive use of drugs. Kress (*Virg. Med. Semi-Mo.*, Nov. 26, '97).

Constipation is met with in two forms: (1) general or peristaltic constipation and (2) rectal constipation; both forms may be present. In the second form most cases begin from the neglect of the habit of periodic relief, and the impairment of the evacuant function of the rectum is the primary feature, the rectum becoming no longer merely a passage and an evacuant, but a mere receptacle like the bowel above. The habitual use of aperients is unscientific; the difficulty is in the lowest portion of the canal and is not properly met by stimulants directed to the bowel generally, or to a large part of it. Hingston Fox (*Gaillard's Med. Jour.*, May, '98).

So-called "dilatation of the colon" has been enumerated among the important causes of constipation both in young children and in adults.

Introduction of a large quantity of water into the intestine recommended in order to diagnose a condition of atony or dilatation. One to $1\frac{1}{4}$ pints are necessary in order to produce the splashing sound in the normal intestine, perceptible in the neighborhood of the transverse and descending colon; while only $\frac{3}{8}$ or $\frac{1}{2}$ pint will produce the sound if there is atony or dilatation; and in such a case it is perceptible first in the sigmoid flexure, then in the transverse colon, and finally in the entire large intestine.

Change of position produces a succussion-sound, and dilatation of the sigmoid flexure may be ascertained, which may be beyond the median line. In the same manner displacement of the transverse colon may be determined, and if simple atony only is present the splashing will be heard in the normal position of the colon, while if there is also displacement the sound will be heard under the umbilicus. It is indispensable to evacuate the intestine with a purgative before performing this lavage. In catarrh of the intestine the water will return charged with mucus and false membrane, while if the intestine is normal the water will be clear or will contain only some slight epithelial *débris*. Boas (*Deutsche med. Zeit.*, Jan. 15, '95).

Two cases of "aneurismal" dilatation of the colon as the result of chronic constipation. In both cases the site of the tumor was the same: in the last portion of the sigmoid flexure. The impaction of fæcal masses in this region tends to produce dilatation behind it, and this distension may be localized or general. General dilatations are relatively common. While the condition of the first case could only be accurately diagnosed at the time of the operation, the great mobility of the tumor which subsequently developed itself in the second case gave rise to the belief that in this instance also would a "pedunculated" tumor be met with, for on various occasions it could be demonstrated bimanually that the lesser cavity of the pelvis was absolutely free, the tumor itself being felt well above the pelvis. S. L. Woolmer (*Lancet*, June 16, 1900).

More or less distension of the colon is a common symptom resulting from accumulation of gases in nearly all the cases of ordinary constipation.

Atony of the intestine should be separated from chronic constipation, which is often only a symptom of the former condition. The atony usually affects the colon, which is unable to expel the fæces. It may be primary, as the result of improper diet, sedentary habits, or a too frequent use of cathartics; or it may be secondary to many disorders, as obesity,

disease of the heart, lungs, or liver, typhoid fever and other intestinal diseases, or organic nervous diseases. It is often found in childhood and may be congenital. The symptoms are marked constipation, headache, vertigo, nausea, and pains in the back and loins. Nervous symptoms are often present. The signs are marked tympany and sometimes the ability to detect the distended colon and faecal masses by palpation. Friedenwald (*Med. News*, Aug. 11, '94).

But dilatation as a primary pathological condition causing constipation, without having been preceded by either intestinal paralysis or some form of obstruction, is certainly of rare occurrence; as recently shown by Mr. Frederick Treves, who suggests "that the cases of idiopathic dilatation of the colon in young children are due to congenital defects in the terminal part of the bowel," and consequent obstruction.

Pathology.—The various pathological conditions accompanying constipation have been sufficiently stated in connection with its etiology and diagnosis. Constipation, when permitted to continue several days, may give rise to irritation or inflammation of the mucous membrane in contact with the retained faeces, causing temporary diarrhoea with pain or tenesmus.

In all cases of chronic constipation there is a considerable degree of chronic irritation and subacute inflammation of the caecum and colon and of the surrounding cellular tissues; this condition not infrequently becomes acute, and is then recognized as an attack of typhlitis. The effect of this subacute inflammation is reflexly to arrest peristalsis. When a purgative is administered in such cases, peristaltic movements are induced, the irritation is increased, and after the evacuation of the bowels, which is rarely complete, the gut becomes more torpid than before. Nevins (*Brit. Med. Jour.*, Dec. 27, '90).

One of the many functions of the ileo-

caecal opening is to prevent the too rapid emptying of the small bowel, and to maintain some pressure against peristalsis until the process of small bowel digestion is properly finished. Mayo (*Boston Med. and Surg. Jour.*, May 16, 1901).

But the more frequent result is the formation of septic materials and their absorption, constituting a degree of auto-infection by which the general feelings of depression, loss of appetite, vertigo, and paroxysms of sick headache are produced.

Emphasis upon the indolence of the caecum occurring in children of sufficient age to be left considerably to themselves. They eat in a careless manner, and frequently eat too much. The food remains in the caecum and large intestine, giving rise to such symptoms as headache, incapacity for study, paleness, and irregular and capricious appetite. Jules Simon (*Revue Gén. de Clin. et de Thér. Jour. des Practiciens*, June, '95).

Study of the history of three hundred cases, showing that about 60 per cent. of all patients suffer from constipation, the number being proportionately larger among women. While the colon and rectum have not the digestive functions formerly credited to them, their absorptive power is great and the quantity absorbed is in proportion to the time of contact and concentration of the substance. The intestinal system is complex. Since all functional action in the system is reciprocal, it follows that the functional activity of the chylipoietic system must affect the nutrition of the brain and entire nervous system. The absorption of toxic and excrementitious substances produces retrograde changes in the quality of the blood, diminution of the red corpuscles, and, by supplying an infected or imperfect nutriment to the brain, becomes a prominent factor in the production of cerebral anaemia and nervous debility. E. S. Pettyjohn (*Med. Rec.*, May 23, '96).

Prognosis.—When constipation is the result of any form of intestinal obstruc-

tion the prospect of permanent relief will depend entirely on the nature and curability of the obstruction itself. But when it depends upon the loss of peristaltic action induced by erroneous habits of life, the prognosis is very favorable, provided the erroneous habits of the patient can be permanently corrected. All such cases can be temporarily relieved by suitable diet, laxatives, and tonic. Relapse, however, will soon follow unless all the primary causes are persistently avoided.

Treatment.—In the treatment of all cases of constipation the use of active cathartics should be avoided as far as possible.

As few purgatives as possible should be used. The methods employed should be: dietetic, physico-mechanical, and medicinal. Such foods should be used as are known to increase peristalsis. Suitable massage is of the greatest value in many cases, but it sometimes fails, and the same may be said of electricity. The usual position taken up in defecation is not the one best adapted for emptying the rectum. In the use of clysters particular attention should be given to the anal parts of the syringe. It should be made of vulcanized caoutchouc, and about 30 to 40 centimetres long. The disadvantage of clysters is that ultimately small quantities of water do not suffice, and then large amounts must be used; the large intestine may thus become overdistended and the injections useless. Regular attempts at defecation with slight pressure should be made. An efficient rhubarb preparation is often very useful, but it may become necessary for the patient to have constant recourse to it. Calomel is especially valuable in children. Castor-oil is not suited for constant use. In some cases, with a certain diagnosis of fæcal tumor, good results are had by combining croton-with castor-oil. Large injections of olive-oil may very properly be recommended. Sometimes sedative and antispasmodic remedies are required where constipation

is of the spastic type. Ewald (Berl. klin. Woch., Mar., '97).

Purgatives excite increased secretion to soften the fæcal contents, and excessive peristalsis by which the intestine is evacuated, but leave the natural functions of the intestines more exhausted than before. Consequently, while they afford temporary relief, they never affect a permanent cure. To secure the latter, the actual causes of the constipation must be ascertained and removed.

Sedentary habits must be abandoned; the effects of in-door occupations counteracted by special open-air exercises mornings and evenings, sufficient to secure full oxygenation and decarbonization of the blood; eating freely of fruit, vegetables, and coarse or brown bread; avoiding all use of alcoholic drinks both fermented and distilled, and instead drinking a glass of natural laxative mineral water each morning, and persistently making an effort to evacuate the bowels directly after breakfast each day.

Reasonable hydrotherapeutics, cold applications to the abdomen, and cold sitz-baths are often of use; moderate exercise helps, but undue exercise, by the loss of moisture by the skin, often increases the constipation. Rosenheim (Inter. Clinics, vol. iv, '97).

The bitter salines are very valuable, and particularly Apenta water, as it is especially indicated in atony of the bowels, and has the advantage that it does not tend to subsequent constipation. Its action is more gentle than that of other bitter waters, because it contains less calcium sulphate and no magnesium chloride; it is probably owed to these circumstances that it does not cause cramps. Bogoslowsky (Trans. Moscow Soc. for the Preservation of Pub. Health, Nov. 6, '97).

The purgatives and alkaline mineral waters are objectionable. In place of them enemata and various disinfectants and drugs intended to strengthen the muscular action of the intestine are em-

ployed. Strychnine and resorcin are particularly effective. Boas (Gaz. Heb. de Méd. et de Chir., Jan. 13, '98).

Sodium sulphate, 75 to 150 grains in a half-glass of water during the meal, recommended. Pills of aloes or of aloes and cinchona are useful. Massage, which has for its purpose the emptying of the large intestine, merits further use. Of the mineral waters, Châtel-Guyon, Brides, and Aulus (source Darmagnac) are preferred. A. Robin (Bull. Gén. de Thér., 16e liv., p. 593, '98).

In functional constipation the new laxative salt of lithia, thialon, has given success. A teaspoonful should be dissolved in a cup of hot water taken in the morning on rising, while, at the same time, excess in nitrogenous foods is to be avoided. The remedy should be gradually discontinued as the stools become regular. A. J. Jenkins (Interstate Med. Jour., Oct., '99).

To aid in restoring intestinal peristalsis a pill or capsule may be given each night containing $\frac{1}{3}$ grain of extract of nux vomica, and 1 grain, each, of extracts of cascara sagrada and of hyoscyamus. If no evacuation takes place the following morning an enema of warm water may be used soon after breakfast.

Forty-six grains of powdered boric acid to be applied directly to the rectal mucosa. In cases where the mucosa cannot be reached, insufflation of the same quantity of powder should be employed. In from one-half to three hours after the application peristalsis occurs, attended with copious faecal evacuations. Flatau (Deutsche med. Woch., p. 976, '90).

Caffeine-chloral administered hypodermically is of value; injections of 4 or 5 grains dissolved in water recommended. Ewald (N. Y. Med. Jour., July 22, '93).

A tablet composed of nux vomica extract, podophyllin resin, belladonna extract, and aloin, $\frac{1}{10}$ grain of each, is excellent for the average cases of long-standing constipation. The tablets should be taken before or after each meal, and, if the effect is too strong, half a tablet, more or less, may be given,

never skipping a dose at the regular time. C. E. Boynton (Med. World, Oct., '97).

Beech creasote is one of the best remedies for habitual constipation. Since employing this drug, a single case has not been found where it was not effective or where it was ill borne. It should be administered pure, twice daily after meals, in doses of 1 to 8 drops, beginning with the smaller and increasing until the desired effect is secured; the vehicle is always water, wine and water, or milk. The result is probably due to neutralizing some intestinal toxin which paralyzes the action of the digestive canal. De Holstein (La Semaine Méd.; Lancet, Lond., Oct. 9, '97).

A common source of error is, in many cases, the belief that accumulation of faecal matter in the large intestine is due to imperfect peristalsis of the bowel, and treatment is directed to it specially, whereas the real need is a modification of the contents of the small intestine. Pfaff (Boston Med. and Surg. Jour., Sept. 9, '97).

Constipation often depends upon the loss of power in the intestinal muscles and lack of secretion of mucus; therefore treatment should consist of massage, proper regulation of the diet, and in the administration of ipecac. Two and one-half drachms of the aqueous extract of ipecac is to be dissolved in 2 ounces of distilled water. One teaspoonful of this is placed in 4 ounces of water and given by rectal injection each morning. Blondel (Jour. de Méd. de Paris, Feb. 11, 1900).

In some cases of special atony of the sigmoid flexure of the colon and rectum aloin or extract of colocynth may be used with advantage instead of the cascara sagrada in the pill. Treated in accordance with the foregoing suggestions, a large majority of the cases of ordinary constipation can be relieved just as long as the patients will faithfully continue correct habits of life.

In the form of chronic constipation due to a spasmodic contraction of the colon treatment should consist in hydro-

therapy, diet, and sedatives. Hot compresses applied to the abdomen and changed every hour or two are the most important remedial agents. For the first few days the compresses should be used also at night. At the same time the patient should receive warm sitz- or general baths. Hot douches (28° to 30° C.) directed first against the abdomen, along the course of the colon, then the lower and upper extremities, for two minutes, are also useful. Large injections of warm water (37° C.) at a low pressure will be found beneficial. Chamomile or, in cases of ulcerative colitis, 1 pint of olive-oil may be advantageously added to the injections. The latter should be used at first every night, then every second or fourth day. The diet should be free from any irritating substances. If considerable intestinal fermentation is present, meat should be restricted and a more liberal vegetable diet allowed. All laxatives, especially drastic cathartics, are harmful. Romme (*La Presse Méd.*, No. 18, 1900).

The troublesome constipation met with in infants can be best overcome generally by giving them fresh air, proper food, and a rectal enema of warm water containing a little chloride of sodium at a stated time each day, without any medicine by the mouth.

When there is alternately diarrhœa and constipation in infants the cause is usually due to an excess of proteids. Essence of pepsin, 10 or 15 drops, should be given after nursing, and abdominal massage is of value. An excellent plan to secure an action of the bowel at a regular time is the insertion of an oil-paper suppository. The constipation of bottle-fed infants being commonly the result of a deficiency of fat in their food, the rational treatment embraces the addition of cream or butter. All forms of teas should be strictly prohibited, and in older children too much potato should not be allowed. Lawrence (*Med. Record*, July 1, '99).

In artificially-fed infants constipation may be due to an insufficiency in the fats or proteids. The addition of a tea-

spoonful of fresh cream for each teaspoonful of condensed milk used is an effective way of relieving the constipation following feedings of condensed milk. Beef-juice is occasionally laxative. When constipation is due to congenital stricture of the anus or rectum, rectal examination will reveal the seat of the difficulty. When nutrition is defective, malt-extracts and codliver-oil may be tried. Enemata should be employed for a comparatively short period only, and saline solution is recommended. Blackader ("*Progressive Med.*," vol. i, Mar., '99).

In infantile constipation excellent results obtained from administration of fresh butter. A half-teaspoonful is given to children of from one to three months, with a spoonful of coffee morning, noon, and night. Children of from five to twelve months are fed with from 1 to 3 teaspoonfuls of butter at evening, every two or three days, this being continued until the stools are regulated. When a normal condition of the bowels is reached the remedy should be discontinued and resorted to again if the trouble recurs. Absolutely fresh butter should be employed. The butter seems also to improve nutrition. M. Dorflier (*La Presse Méd.*, June 6, 1900).

In chronic constipation of infants and young children best results are obtained by careful attention to diet, exercise, and being much in the open air, avoidance of living in overheated apartments, massage, and regularity of time for the evacuation. G. W. Cook (*Amer. Jour. of Obstet.*, Oct., 1900).

In the rare cases in which a fair trial of enemas and suppositories does not succeed a few drops of the elixir of cascara sagrada may be given each evening.

Excellent results have followed the use of both the oil and glycerin enemata in the treatment of constipation.

Obstinate constipation and intestinal diseases may be successfully treated by enemata of oil, after the method of Reiner. Olive-oil is the best, but, as it is rather costly, purified rape-seed oil

may be used. The injections are made slowly and carefully, and the patients are told to retain the oil as long as possible, sometimes for several hours. Every day an injection of $1\frac{1}{2}$ to 8 fluidounces of oil is made, with the result that defecation becomes easy, the flatulence diminishes, and in cases where the mucous membrane of the bowel is more seriously affected the ulcers and chronic catarrh improve. Halk (*Ugeskrift f. Läger*, p. 601, '96).

[The method of treatment by glycerin enemata has received thus far only universal commendation. Administered in the form of suppositories it is equally efficient. The only objection to enemata of glycerin offered by patients is the tingling sensation felt in the rectum after the injection, and this can be obviated, without interfering with its action, by adding an equal quantity of water to the glycerin. W. W. JOHNSTON, Assoc. Ed., *Annual*, '92.]

Massage is gradually affirming its value. In conclusions based upon study of 147 cases, le Marmel showed that (1) mechanical treatment can be classed among those therapeutic agents whose action on the circulation, respiration, and general nutrition is decidedly energetic; (2) that it modifies the abdominal circulation and dispels certain passive congestions, especially those of abdominal plethora; (3) that it increases the muscles in volume and strength; (4) that it is the best curative agent for constipation from muscular paresis or paralysis not due to central nervous disease; (5) that it is the best curative agent for constipation dependent on hypoesthesia or anæsthesia due to local causes; and (6) finally, that it is formally contra-indicated when the constipation is due to acute inflammation or to tumors.

In children massage removes the cause which is the most frequent: *i.e.*, atony of the muscular coat. It failed in no case in which it was thoroughly tried. It was done usually about 2 P.M., and

a stool followed frequently within fifteen or twenty minutes after the manipulation, usually before evening of the same day. Karnitzky (*Archiv f. Kinderh.*, p. 66, '90).

Method of treating constipation followed by good results: The patient is made to lie upon a bench about thirty-two inches wide covered with a hair mattress, and clad in light-flannel underwear, the head supported by means of a pillow, and the knees bent up. The large intestines only, from the cæcum to the rectum, are massaged, as it is usually in that portion of the intestinal canal that fecal masses are formed and retained. Considerable force is employed, the large intestines being pressed against the ilium by means of the fingers held stiff. J. Schreiber (*Wiener med. Presse*, B. 36, p. 808, '95).

The following process of massage for constipation is far more efficient than the usual process. The patient is placed on his right side and the operator picks up with his thumb and index of each hand the skin and the subcutaneous tissue at the level of the iliac spine. This makes the intestine directly accessible to the other fingers, and he manipulates it with them, always pressing from above downward, and with the ends of his fingers, for five minutes. Then the patient is turned on the left side and the process is repeated on the cæcum, and the ascending colon, only in the opposite direction, from below upward. This leaves only the small intestine and the transverse colon to be massaged, for which the patient is placed in the decubitus genupectoral position, as this relaxes the abdominal walls and brings the intestines closer into the hand of the operator. Kümmerling (*Sem. Méd.*, Dec. 5, '95).

For constipation in infants under 12 months old that cannot be relieved by regulation of diet, massage is recommended. It should be given only in the morning, for not more than ten minutes, and the movements made in a circle about the umbilicus; pressure should be light and exerted especially in the right iliac region. For babies more than a year old the finger-tips are exclusively employed and the movements are con-

fined to the course of the large intestine, from right to left. Carrière (*The Practitioner*; N. C. Med. Jour., Dec. 5, '97).

To perform abdominal massage the mother anoints her hand with sweet oil or vaselin and slowly and carefully kneads the abdominal walls, grasping the superficial structures and rubbing them upon the underlying ones, following, respectively, the course of the ascending, transverse, and descending colons, and ending with a circular movement of the hand around the umbilicus. J. Madison Taylor (*Phila. Polyclinic*, May 28, '98).

Electricity and hypnotic suggestion have also been recommended. The first may be classed as an adjuvant to massage of no mean value in cases of intestinal atony, while the third may be considered as meriting as yet but little confidence.

The theory that constipation depends upon an hypertrophy of the rectal valves is a distinct advance and eminently practical. The rectal valves are always present, they are definite anatomical structures, and they may become pathological and obstructive. In observing the cavity of a rectum with thickened valves, one cannot fail to note the rigidity and elasticity of these bands, which jump across the view and span two-thirds of the calibre of the canal when relieved by the withdrawal of the proctoscope. The lower, or first, valve is at right angles with the gut axis, while the second and third are obliquely placed; so that it is evident that the first may be more obstructive. It requires the rarest judgment to determine when the valve should be cut or when massage will overcome the obstruction. The instruments required for valvotomy are proctoscopes of graded lengths for each valve to be treated, a test-hook to determine the depth of the valves, two tenacula to secure position of the valve, a valvotome, a curved needle and shot compressor, and an electric headlight. The patient is placed in the genu-pectoral position and the proper proctoscope introduced. The se-

lected valve is sprayed with a 1-per-cent. solution of cocaine and the surface is mopped with a concentrated solution of suprarenal extract. The test-hook determines the point of safety and depth at which the structure may be divided. The tenacula are put in place and the division effected with the valvotome. Two incisions are made on each valve by transfixing and cutting out through the tendinous margin. A suture is placed in the angle of the gaping wounds to lessen the area which must granulate and to prevent a possible peritonitis. The dangers are hæmorrhage and peritonitis. The patient is given a daily saline and a hot enema for two weeks. Beach (*Penna. Med. Jour.*, July, 1902).

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CONTINUED FEVER. See MALARIA.

CONTUSION. See WOUNDS.

CONVALLARIA MAJALIS.—The lily of the valley, a native alike of Europe and North America, has long been held in high repute in Russia, Germany, and Scandinavia as a plant possessed of great therapeutic virtues, rivaling those of purple fox-glove. It is a perennial; has a creeping, much-branched rhizome of about the thickness of a quill; two or three elliptical and smooth radicle leaves; a one-sided raceme of light, ten or twelve nodding, bell-shaped, six-lobed, white flowers; very fragrant, but of acrid and bitter taste. As found in shops, it appears in cylindrical, wrinkled, whitish pieces marked by circular scars; at the annulate point, eight or ten rootlets. Both the rhizome and the roots are medicinal.

The active principles are two glucosides, denominated, respectively, convallamarin and convallarin: the first a pale-whitish-brown amorphous powder, soluble in both alcohol and water; the

second a brownish-white powder soluble in alcohol only.

Preparations and Doses.—Convallaria extract, solid, 5 to 15 grains.

Convallaria extract, fluid, 2 to 20 minims.

Convallaria infusion (10 grains of flowers to 6 ounces of water), 2 to 8 drachms.

Convallamarin, $\frac{1}{4}$ to 2 grains.

Convallarin, 2 to 4 grains.

Physiological Action.—Moderate doses slow and strengthen the heart's contractions; larger doses accelerate the heart and induce irregularity; toxic doses cause progressive paralysis, muscular tremors, complete loss of reflex action, and death when the heart is arrested in systole. Doses that slow the heart heighten arterial tension; it probably also acts directly upon the blood-vessels. Like digitalis, it is a most efficient diuretic when given in the form of an infusion, but is apt to be uncertain in its effects upon the kidneys when exhibited in any other form; it is also emetic and cathartic. While the effect upon the circulation is very like that of fox-glove, it is a more uncertain remedy, and likewise a less powerful one.

Convallamarin reduces the pulse-rate, markedly increases the flow of urine, and is "cumulative" in exactly the same way that digitalis is: *i.e.*, when exhibited in a way that fails to provide for or secure proper elimination; because of this "cumulative" bugbear, it has been suggested that more than one dose during twenty-four hours should not be administered to the same patient; but this precaution is entirely superfluous if the drug is exhibited intelligently and its effects carefully watched. This glucoside, however, is in every way inferior to preparations of the entire drug, and all the latter are inferior to the infusion.

Convallarin is both emetic and purgative.

Case of child, aged 2 years, who took nearly a teaspoonful of the fluid extract. She became extremely restless, showed a continual trembling in the arms and legs, and once general convulsions. She was aroused with great difficulty, and immediately relapsed into stupor. The pupils were moderately dilated. The axillary temperature was 97° F.; pulse 140 at times, at others too rapid to be counted, but always exceedingly irregular. Respirations were shallow and superficial, increased somewhat in rapidity, but were very regular. Face was somewhat flushed. Gastro-intestinal, renal, and skin irritation were absent. Under symptomatic treatment child gradually regained normal condition. J. H. Andrews (Ther. Gaz., No. 2, '98).

Therapeutics.—CIRCULATORY DISEASES.—Opinions differ greatly as to the value of the drug. By a score of observers it has been extravagantly lauded and by as many more condemned with proportionate severity. It should be remembered, however, that the strength of the different preparations of different manufacturers vary. Again, some employ the petals of the flowers only; some the rhizome; some the root; some the entire plant. Justice demands a standard be set, and the plant studied more carefully from such definite stand-point.

In dropsy of renal or hepatic origin convallaria majalis in an infusion of 4 grammes of the plant to 180 grammes of water, a tablespoonful every 2 hours, changing later to a 1 to 12 alcoholic tincture, of which 45 to 80 drops are taken during the day, is valuable. It also favorably influences the diuresis in hepatic cirrhosis. Jabowski (Sem. Méd., Mar. 10, '98).

CONVULSIONS, INFANTILE. See SPASMS AND CONVULSIONS IN CHILDREN.

COPAIBA.—"Balsam" copaiba, or copaiva, is the common designation of

this drug, but is exceedingly inappropriate, since it contains neither of the requisites of a true balsam, viz.: benzoic or cinnamic acid. It is, in fact, an oleoresin supposed to be derived from *Copaifera Langsdorffii*, but as frequently, perhaps, had from other, but relative, sources, such as *C. officinalis*, *C. multijuga*, *C. Guianensis*, *C. coriacea*, *C. nitida*, *C. Martii*, *C. cordifolia*, *C. Jusseui*, *C. Jacquinii*, etc., all indigenous to South America or the West Indies and the valleys of the Madeira, Orinoco, and Amazon; the best comes from Belem (Para), as its average of volatile oil is larger, ranging from 60 to 90 per cent., while its most important rival, Maranh copaiiba, at most never yields more than 80 per cent. and seldom more than 40, which last equals that of Maracaibo.

Para copaiiba is pale colored and limpid, Maranh and Rio Janeiro of an olive-oil consistence, and all three form clear mixtures with one-third to one-half their volume of ammonia-water, but milky if more alkali or fixed oil is present. Maracaibo—and all dark copaiibas obtain this name commercially—is thick, dark yellow or reddish brown, turbid, and solidifies with magnesia. Besides the volatile oil is contained a resin and bitter principle known as copaic acid: oxycopaic acid from the Para form, metacopaic acid from that dubbed Maracaibo. The odor is peculiar and characteristic; the taste, hot, nauseous, and bitter; is freely soluble in ether, alcohol, fixed and volatile oils, but not at all in water unless it is previously rendered alkaline.

Copaiba-oil is obtained by distillation, and in this the therapeutic virtues of the oleoresin chiefly reside. It is a pale-yellowish liquid; aromatic; bitter, pungent taste and characteristic odor; that

from Maracaibo copaiiba has a dark-blue tinge.

Unfortunately copaiiba is rarely obtained in its purity; that in the shops is usually adulterated with turpentine, gurgun balsam, or castor- or linseed- oils.

Preparations and Doses.—Copaiba (oleoresin), 5 to 15 grains or minims.

Copaiba injection, urethral (copaiiba, 10; sodium bicarbonate, 5; tincture of opium, 1; distilled water, to make 768 parts), *ad libitum*.

Copaiba mass (solidified copaiiba, 10 to 60 grains) speedily becomes insoluble.

Copaiba mixture (copaiiba, 6; liquor potassa, 4; gum-arabic mucilage, 8; spirit of nitrous ether, 24; cinnamon-water, 64), 2 to 5 drachms and more.

Copaiba mixture, Chopart-Wolff's (copaiiba, 8; syrup of Tolu, 8; alcohol, 8; spirit of nitrous ether, 1), 2 to 5 drachms.

Copaiba-oil 3 to 15 minims.

It may here be noted the custom of making pills of copaiiba by the aid of magnesia carbonate, and by mixing with wax, is pernicious; neither pill-mass is freely soluble, and absorption of the remedy is restricted and in a measure inhibited.

Physiological Action.—Applied locally both the oil and the oleoresin appear to be slightly stimulant. Internally in medicinal doses they stimulate the kidneys to freer action, without, however, materially affecting or modifying the solid constituents of the urine.

The diuretic action is produced by the effect of the drug upon the renal secretory nerves, and not by dilatation of the blood-vessels of the kidneys, as believed by Binz. Obelensky (Brit. Med. Jour., Aug. 8, '91).

When copaiiba is taken normally, a reducing substance appears in the urine, which responds to Trommer's test, but not to Nylander's or the fermentation-

test, and deflects polarized light to the left. This levorotatory substance belongs to the paired glycuronic acids, and may easily be mistaken for sugar, the more so as free glycuronic acid is dextrorotatory like glucose. But glycuronic acid is not fermentable with yeast. Bettman (Berliner klin. Woch., May 29, '99).

Copaiba stimulates mucous membrane generally, more especially of the genito-urinary and respiratory tracts; is somewhat feebly astringent, and decidedly antiseptic. Its prolonged use is not unattended with danger and is apt to induce considerable gastro-intestinal irritation, gastric oppression, anorexia, nausea, vomiting, purging, and congestion of the upper air-passages, of the conjunctiva, irritation of bladder and kidneys, perhaps to the setting up of a nephritis or cystitis, or both. Unpleasant skin eruptions accompanied by inordinate itching and tingling are common sequels to its use; usually these consist of bright-red papules closely resembling the efflorescence of measles, but sometimes scarlatina-like. They begin on the hands, gradually spreading to arms, trunk, and lower extremities.

The drug is very rapidly absorbed into the circulation, and is eliminated chiefly by the kidneys and respiratory tract, and to some extent by the skin.

The elimination of copaiba by the lungs is insignificant and almost *nil*. Binet (Revue Méd. de la Suisse Rom., July 30, '93).

Binet's conclusions, however, cannot be accepted as final, and are not borne out by evidence.

Copaiba Poisoning.—Copaiba is certainly toxic, though there is no definite evidence of its ever having been a direct cause of death. Indirectly it is accused of giving rise to severe manifestations resembling rheumatic seizures and to renal dropsy. The toxic symptoms are those accruing to large or long-continued

doses, greatly exaggerated, along with weakening of arms, of muscles, of face; paralysis; desquamative and pustular eruptions, and, more rarely, tetanoid seizures.

The drug has a manifest effect upon the skin and is likewise an epithelial irritant; but its action appears to be greatly influenced by individual susceptibility. Assuming that symptomatic dermatitis ensues as part of a general excretory action, the practical conclusion must be that all drugs which produce eruptions should be prescribed with caution lest they injure other organs. Walsh (Med. Press and Circ., No. 3058, '97).

Treatment of Copaiba Poisoning.—

The toxic symptoms are rarely such as to require measures other than withdrawal of the drug and the promoting of excretion by all the emunctories. Diuretics and cathartics may be employed, and cannabis Indica or opium used to allay pain.

Therapeutics.—As a whole, copaiba promises little therapeutically that cannot be more palatably and easily obtained through the use of oleoresin of cubeb, oil of turpentine, and other agents of this class. If prescribed, it is best given in capsules, preferably dissolved in some bland oil. It frequently appears in capsular form in conjunction with oil of sandal-wood, or eucalyptus, or cubeb. In mixtures its nauseousness may, in part, be overcome by the use of spirit of chloroform, chloroform-water, and aromatics. The oil is, in every way, a preferable preparation to the oleoresin, being a more constant and definite agent.

GONORRHEA.—It is in this malady that copaiba has found chief employment, solely because of its antiseptic properties and affinity for mucous tissues; and for all that many practitioners in the management of this malady still rely on this drug, alone or in conjunction

with other diuretics or drugs of the same class. It is much overrated, and its real merits are nowise compensatory for the nausea and disagreeable sequels that follow in its train. Again, the uncertainty attending the character of the drug *per se* is such that oleoresin cubeb, which is equally effective, is a more desirable remedy, although perhaps less diuretic, but even in this respect it may be rendered superior to copaiba by the addition of an extremely minute quantity of cantharides. Copaiba is also used as a urethral injection.

LEUCORRHOEA.—The internal administration of copaiba often seems beneficial in the fluxes of females, and also the pudendal eruptions that accrue to or are sequels of these discharges.

PULMONARY DISEASES.—These, when attended by excessive secretion, are often benefited by this drug; it is especially available in restraining and modifying bronchial secretion, more particularly in the aged; but it is inadmissible when there is much vascular irritability or fever.

HEPATIC DISEASES.—In cirrhosis of the liver copaiba, especially when combined with cardiac disorders, has been found of considerable value.

Eight cases, 4 of mitral insufficiency, 1 of aortic regurgitation, and 3 of atrophic cirrhosis, were treated with copaiba, and in all excellent results obtained. The remedy seems to be superior to all other diuretics, especially in cases of dropsy of cardiac and hepatic origin. Obelensky (Brit. Med. Jour., Aug. 8, '91).

The diuretic action of copaiba in hepatic cirrhosis is incontestable, and is energetic when compared to other drugs of this class. Georgiewsky (Le Bull. Méd., No. 44, '92).

In 3 cases of hepatic cirrhosis, 1 of cardiac insufficiency complicated with cirrhosis, 1 of hepatic cancer, and 1 of pleural effusion and apical tuberculosis

it was entirely satisfactory as a diuretic. Bronowski (Gaz. lekar., No. 29, '93).

GONORRHOEAL RHEUMATISM.—It has been claimed that this drug is eminently serviceable in the management of gonorrhoeal rheumatism, but that it must also be given in very small doses and persisted in for some length of time; also that colchicum may be advantageously connected therewith. But the rationale of the foregoing has never been elucidated.

SKIN DISEASES.—Externally the drug has been recommended in the treatment of chronic skin diseases, notably psoriasis, lepra, lupus, etc., but its value therein is decidedly problematical, except for its antiseptic and stimulating effects. Also it has recently been revised as a dressing for chronic and indolent ulcers, though its value here is no greater than—if as good as—that of many balsamic resins.

COPPER.—Copper is a metal that in its pure state appears to exercise little or no effect upon the human economy, but acts as an irritant poison in combination with acids, no matter whether the combination is effected within or without the body. Food cooked in copper utensils that are not kept constantly polished in their interior, by dissolving a portion of the metal, and converting it into salts, proves highly toxic; like transformations occur through the secretions by inhaling or otherwise absorbing fine particles, as, for instance, in coppersmith's and brass-maker's disease. In medicine its chief value is as a base for the formation of salts. It forms two oxides, red and black, known, respectively, as cuprous and cupric, the latter alone being employed therapeutically.

Preparations and Doses.—Copper acetate, normal, $\frac{1}{8}$ to $\frac{1}{2}$ grain.

Copper aluminate, mild caustic only.

Copper and ammonium sulphate (ammoniated copper), $\frac{1}{4}$ to 3 grains.

Copper arsenate, $\frac{1}{25}$ to $\frac{1}{8}$ grain. See ARSENIC.

Copper arsenite, $\frac{1}{124}$ to $\frac{1}{2}$ grain. See ARSENIC.

Copper benzoate, external use only.

Copper bichromate, caustic only.

Copper bromide, $\frac{1}{150}$ to $\frac{1}{8}$ grain.

Copper carbonate, 1 to 6 grains.

Copper chloride, $\frac{1}{16}$ to $\frac{1}{8}$ grain.

Copper diacetate (subacetate), external use only.

Copper iodide, $\frac{1}{300}$ to $\frac{1}{100}$ grain.

Copper nitrate, $\frac{1}{12}$ to $\frac{1}{6}$ grain.

Copper oleate, external only.

Copper oxide (black), $\frac{1}{4}$ to 1 $\frac{1}{2}$ grains.

Copper penta sulphate, in technical use only.

Copper phosphate, $\frac{1}{8}$ to $\frac{1}{2}$ grain.

Copper salicylate, external use only.

Cupratin, 1 to 4 grains.

Cuprein. See CINCHONA.

Metallic Copper.—Though pure metallic copper is generally held to be inert *per se*, it is sometimes employed in chole-
raic maladies, colic, and seizures of like character. The virtues, whatever may exist, most assuredly must arise from the chemical change that takes place within the body; probably a chloride is formed there.

Copper Acetate.—Normal copper acetate is by no means the basic acetate, and the latter finds only technical application. The former, known also as verdegris, and crystallized verdegris, if pure, is obtained in conglomerations of large, dark-green crystals; has a metallic taste and acetous odor; melts at 328° F.; is decomposed by water; soluble in water

and alcohol. It requires to be kept well stoppered.

Ammoniated copper, or more properly copper and ammonium sulphate, appears in the form of a dark-blue, crystalline powder, freely soluble in water, and is regarded as an astringent and antispasmodic remedy.

Copper arsenate varies in its form and composition; it should appear as a blue powder, and is freely soluble only in acids; it is little employed, but at one time held high rank as an alterative and antisyphilitic.

Copper arsenite (ortho-arsenite of copper, or Scheele's green) is a pale- or yellowish-green, amorphous powder, soluble in alkaline solutions, slightly soluble in water, and claimed to be antispasmodic and also an intestinal antiseptic. See ARSENIC.

Benzoate of copper is made up of light-blue, crystalline plates or needles, though it is sometimes obtained in powder. It finds no employment at all by way of the stomach.

Copper bichromate is a deliquescent, brown, crystalline salt that requires to be always kept in a closely-stoppered bottle; it is soluble in water and in alcohol, and of but little use at all except for its caustic action.

Bromide of copper, like every other bromine derivative, has been tried in lieu of other bromides, especially in chorea and epilepsy, but was speedily found to be a remedy for evil rather than good, and highly irritating to the stomach. It is a grayish-black, crystalline powder resembling graphite, but soluble in water.

Copper Carbonate.—There are two forms of copper carbonate, viz.: the blue (sesquicupric carbonate), which is used only as a pigment; and the green carbonate (dicupric carbonate, or artificial

carbonate), which is obtained in powdered form and is soluble in acids only. It has been chiefly employed as an antidote in phosphorus poisoning.

Chloride of copper has been employed on a few occasions as a remedy and as a substitute for the sulphate, but it possesses no advantages over the latter, and is even more caustic; it finds its principal use in the laboratory of the chemist.

Nitrate of copper (normal) appears as deep-blue, prismatic, deliquescent crystals, obtained by dissolving the metal in nitric acid, evaporating, and cooling at a temperature not lower than 70° F. It is soluble in water and alcohol, and by the late Dr. Fleming was held to be superior to all other caustics in lupus, malignant ulcerations, and the small excavated semiphagedenic ulcers which occur on the genital organs of both males and females. It is very deliquescent, and can only be applied in a liquid state, the surrounding parts being well protected by oil. It differs from the sulphate in exciting a stronger, healthy or alterative action in the tissues around the ulcer after its destruction. A capital detergent lotion is had by dissolving 2 minims of the liquid nitrate of copper in an ounce of water. It has been administered internally as an antisymphilitic, but without sufficient success to encourage its further use.

Oleate of copper, so called, is really an oleopalmitate, and is best prepared by the double decomposition of a hot solution of cupric sulphate (3 to 8 of water) added to a hot solution of Castile soap (8 to 32) and washing and drying the precipitate. On cooling it forms in solid, dark-green masses that may be subsequently pulverized. It finds chief employment in plasters for warts and corns. An ointment is sometimes made by adding 1 part of cupric oleate to 4 parts of

an ointment-base, preferably one made with 2 parts of vaselin and 1 part of paraffin.

Black oxide of copper—there is a red oxide also, but it only finds technical employment—or cupric monoxide, is a brownish-black, amorphous powder that has been employed as a tænicide and resolvent.

Phosphate of copper is a bluish-green powder, at one time heralded as a panacea for tuberculosis.

Copper salicylate appears in the form of bluish-green microscopical needles that are soluble in water, and has found its chief use as an antiseptic application.

Copper sulphate, sometimes termed blue vitriol, occurs as large, deep-blue, efflorescent crystals of strong, metallic, styptic taste. It is soluble in 2.6 parts of water at 59° F., in 0.5° F. of boiling water, and 3.5 parts of glycerin; insoluble in alcohol: decomposed by alkaline carbonates, borax, lead acetate, silver nitrate, mercuric bichloride, calcium chloride, and precipitated by all astringent vegetable infusions. It is mildly escharotic, irritant, and in weak solutions stimulant and astringent; in large doses emetic, but undesirable, and oftentimes dangerous as such, except in cases of phosphorus poisoning, when it proves of special value because of the chemical changes induced.

Copper sulphide, cupric and copper sulphide cuprous, have been employed as external applications in various degrees of dilution, but with no very satisfactory results: they are of more value to the technical chemist than to the physician.

Cupratin is a copper albuminoid preparation analogous to ferratin.

Copper ointment is had in two forms, one of which is also termed a liniment. Thus, copper ointment proper—which obtains the synonyms of *unguentum*

æruiginis, Egyptian ointment, and verdigris ointment—is made by incorporating 30 grains of the finely-powdered diacetate (“prepared subacetate”) salt with $7\frac{1}{2}$ drachms of ointment-base, preferably that made with white wax. It is a mild stimulant and escharotic.

The copper liniment, also known as *linimentum æruiginis*, *oxymel cupri subacetas*, *unguentum Ægyptiacum*, is a stimulant, detergent, and slightly-escharotic preparation, made by dissolving 1 ounce of cupric diacetate in 7 ounces of distilled vinegar, and then adding 14 ounces of honey.

Physiological Action.—All the copper salts are more or less astringent both in substance and solution, the difference for the most part being those of degree; applied to abraded surfaces, they are caustic. Internally they are gastro-intestinal irritants. Though often tonic in minute doses, they are not generally well borne for any length of time, but, like the ingestion of single large doses, provoke nausea, perhaps vomiting, and salivation and purging of blood and mucus. They are also depressant to the nervous system; to the respiratory action, which is likewise accelerated; and to the heart's action, causing a small, weak, rapid pulse. Minute doses augment all the secretions. All are but slowly absorbed and even slower eliminated, this process taking place by way of the *prima viæ*, the salivary glands, the kidneys, and liver, and there is always a tendency to accumulate in the latter organ.

Copper salts probably exist in the blood as albuminates. Some observers have noted a gain in flesh in animals and man after a course of copper, but when persisted in too long the salts give rise to symptoms similar to plumbic poisoning, viz.: constipation, paralysis, etc. Biddle (“Mat. Med. and Therap.,” '96).

Internally copper leaves the irritability of the muscles unaffected, but dimin-

ishes the total amount of work they are able to do, and also causes powerful contraction of the blood-vessels. Armstrong (Foster's “Prac. Therap.,” '96).

People who work in the copper mines are liable to a peculiar greenish coloration of the hair, regardless of its original hue. The beard and moustache are first affected, then the hair of the scalp; and the metal can be demonstrated in the hirsute growth chemically, and under the microscope the color is seen to be uniformly distributed.

It will be observed that the physiological action of copper salts within the economy is largely speculative; they are not employed therapeutically sufficiently often to excite special studies in this direction, though such are greatly to be desired.

Poisoning by Copper Salts.—Here the arsenical copper salts must be excluded, as they partake of the nature of arsenic (see ARSENIC). As regards the others, this action is pretty nearly coincident and uniform, and chiefly exaggerations of their effects in large medicinal doses. The symptoms are: vomiting, pain in bowels, cramps in lower extremities, strong coppery taste in mouth, diarrhœa, convulsions, paralysis, insensibility, and death; marks of inflammation in the stomach and intestines are often noticed at the post-mortem, and, where the case has been protracted, there is often a green tinge of the lining membranes of the *prima viæ* and a jaundiced appearance of the skin.

Acute poisoning results from the inhalation of copper fumes, eating fruits cooked in copper utensils, or from an overdose of a copper salt. When inhaled, the first symptoms are those of bronchial catarrh and irritation. Internally administered the symptoms do not usually appear at once; but after an hour's interval there are manifest a strong metallic taste in the mouth,

burning and constriction of the pharynx and fauces, salivation and vomiting of greenish matter, and purging, the passages after awhile containing mucus streaked with blood. There are present, also, burning in the epigastrium and griping, colicky pains. A characteristic symptom is a green line on the gums. Sometimes jaundice may be present; and headache, convulsions, suppression of urine, cardiac depression, and hurried respiration are among the more grave symptoms. Butler ("Text-book of Mat. Med., Pharm., and Therap.," '96).

In four cases, all with a previous history of good health, there was a sudden onset of gastric disturbance more or less severe, speedily followed by pains accompanied by dysphagia, cramps, headache, and vertigo. Vomiting terminated the severity of the symptoms. Gentile (*La Riforma Med.*, No. 42, '96).

Case of copper poisoning apparently due to the handling of vines that had been treated on three or four occasions with applications of a solution containing copper. Danet (*Le Bull. Méd.*, '97).

It is only in acute conditions that poisoning by copper salts can occur, and then it is not a question of true poisoning, but of a gastro-intestinal irritation analogous to that which is produced by a common caustic. Very exceptionally are serious symptoms of poisoning observed, as the organism has the greatest tendency to free itself from substances which possess emetic properties. Galippe (*Nouv. Remèd.*, July 8, '97).

Method of testing copper salts for coloring green pease: Green pease were boiled in a solution of copper sulphate until they had absorbed all the copper in the solution. Then fresh pease were boiled in water for the same length of time. Next a few of the colored pease and a few of the uncolored were boiled for three minutes in a 10-per-cent. solution of sulphuric acid. Each sample was then poured out on a white saucer. The pulp of the colored pease as well as their skins always retained the green color after this test in a degree which was proportionate to the quantity of copper present, while the pease that had not been colored turned a brownish or gray-

ish black. By this method so small a quantity as 0.025 gramme of copper in a kilogramme of pease was detected. A. V. Nikitine (*Vratch*, Mar. 11, 1900).

Symptoms of greatest value in the recognition of copper poisoning are (1) dyspepsia, which is the earliest of all symptoms; (2) anæmia, which comes on before emaciation, loss of strength, and the rather characteristic painful facial expression; (3) nervousness and irritability. H. A. Kurth (*Med. Record*, Nov. 10, 1900).

Treatment of Copper Poisoning.—Albumin and milk form an insoluble compound with copper salts, provided they are in large excess. They should be preceded by prompt evacuation of the stomach, but the stomach-pump is of little avail when the salt is in coarse particles. Vomiting may be prompted by copious draughts of warm water, etc., and lavage may serve an excellent purpose. Ferrocyanide of iron is also recommended to be given to form an insoluble copper cyanide; the hydrated succinate, the protosulphuret and hydrate oxide, and protosulphuret have also been employed. Opium is usually necessary to allay gastro-intestinal irritation and relieve pain.

Any antidote to be of avail must be given at once and act quickly. Milk and eggs are almost always at hand, and are the most efficacious antidotes. No time should be lost in attempting to separate the yolk from the white of the egg, but the egg should be broken into a bowl as quickly as possible, a little water added, and the whole stirred up and exhibited. The dose should be repeated several times, especially when there is vomiting. Soap or fixed alkali may be given. The yellow prussiate of potash, when pure, is harmless, and precipitates instantly an insoluble compound of copper from solutions of its salt; when it is to be had in time, it may, therefore, be used as an antidote to the sulphate. H. C. Wood (*Princ. and Prac. of Therap.*, '94).

As Emetics.—Copper salts act as emetics without causing much depression of the nervous system, but the sulphate is invariably preferred, since the doses and its cheapness render it more manageable and convenient.

Copper sulphate is more irritating and less prompt as an emetic than the zinc sulphate, and when administered without effect it is best not to repeat it. Stevens ("Manual of Therap.," '94).

To empty the stomach in case of poisoning, make ten powders of a mixture of 30 grains of copper sulphate and 120 grains of white sugar (powdered sugar), and give a powder every ten minutes until vomiting is produced. Roth ("Mod. Mat. Med.," '95).

Therapeutics.—The copper preparations have had a varied and checkered reputation as remedial agents, and have been tried, chiefly on empirical grounds, in a large number of maladies.

ANÆMIA AND CHLOROSIS.—Formerly they were in repute as "blood-making" agents, and employed in anæmia and chlorosis, and they still retain the confidence of many practitioners, especially where the anæmia is characterized by a bluish color of the skin, the acetate salt having the preference.

For chlorosis and functional anæmia, arsenite of copper is given in doses of $\frac{1}{80}$ to $\frac{1}{25}$ grain, two or three times daily; but in these conditions hæmoglobinometric examinations have not shown that it is superior to other forms of arsenic. Armstrong (Foster's "Prac. Therap.," vol. i, '96).

CONVULSIVE AND SPASMODIC DISEASES.—More than in any other class of maladies, perhaps, copper has held its own in the management of chorea, epilepsy, hysteria, croup, etc., etc. (see LARYNGITIS, *post*). In epilepsy especially, the ammoniosulphate has been employed, oftentimes with advantage, in doses of $\frac{1}{2}$ grain, in pill form, night and morning, increasing every second day by

$\frac{1}{8}$ grain. The sulphate in gradually ascending doses has been used in both epilepsy and chorea; it is advised for the former malady to combine it with quinine; it was likewise a favorite remedy of Sir Benjamin Brodie in obstinate hysteria.

In croup, too, the sulphate salt was formerly extensively employed, first to obtain relief by prompt emesis, and next in small doses every fourth- or half-hour for the purpose of checking excessive secretion from the lining membrane of the bronchial tubes and cells. The reports regarding the use of the drug in the past are most favorable.

Copper sulphate is supposed to exert an especial therapeutic action on the larynx; hence it is sometimes given in croup, and for a double reason, therefore, is used when it is necessary to expel any obstructive substances from the glottis by the mechanical efforts of vomiting. Ringer and Sainsbury ("Hand-book of Therap.," '97).

GENITO-URINARY AND VENEREAL DISEASES.—By reason of their astringency, copper salts are frequently employed in weak solution for the treatment of gonorrhœa, leucorrhœa, cystitis, etc., and in solution or crystal as topical applications to chancres and other syphilitic sores and internally in lieu of the mercury salts. In gonorrhœa and leucorrhœa, a solution of ammonium sulphate, 15 grains to 2 or 3 ounces of fluid, is occasionally serviceable; again, a solution of the sulphate, 8 to 10 grains to an ounce of solution of subacetate of lead, the whole diluted with 8 ounces of water, is often employed for the former malady; in leucorrhœa, 40 to 60 grains to a pint of tepid water.

For syphilitic ulcerations, the deliquesced copper nitrate is frequently the most suitable application.

From 2 to 4 grains of subacetate of copper dissolved in an ounce of water is

one of the best injections for gonorrhœa; in the latter stage of the disease its effects are particularly good. Goss ("Mat. Med., Pharm., and Spec. Therap.," '89).

In syphilis the sulphate of copper is superior to mercury in its effects on the lymphatic system. The cutaneous secondary manifestations disappear but slowly under its influence, but it prevents the development of mucous plaques and laryngeal accidents; on account of its great activity, it is advisable to interrupt the treatment one or two days in a week. Patients at first have a great appetite; but, if the drug be too long continued, they suffer from prostration, vertigo, and pallor, with rapid, weak pulse. It is best administered in doses of $\frac{1}{32}$ grain, in pills or potion as may seem best, three times daily; sulphate of iron may be added if it seems advisable. But even this dose is dangerous when there is syphilitic cachexia, and smaller doses should be given to begin with, gradually increasing to $\frac{1}{10}$ grain as tolerance becomes established. Price (N. Y. Med. Rec., Nov. 5, '94).

DISEASES OF MOUTH AND THROAT.—In the sore throat of scarlet fever, a gargle of sulphate of copper, 1 grain to the ounce of water, is sometimes used. The finely-powdered salt, incorporated with honey (10 grains to 1 ounce), is an old remedy for cancrum oris, aphthous ulcerations, and gangrenous affections of the mouth.

Sulphate of copper may be used as a gargle in relaxed sore throat. The aphthæ in aphthous stomatitis are benefited by touching with a copper-sulphate solution.

The soluble salts of copper combine in the mouth with the liquid albuminous substances of this cavity, and precipitate them more or less completely. The sulphate in solid form may be applied with advantage to the spots of psoriasis, simple or specific, that affect the tongue. Applied in solution along the edges of the gums in ulcerative stomatitis, it generally quickly heals the ulcerated

surfaces, though, on the whole, alum is to be preferred. A weak solution painted over the mucous membrane will remove the white, curdy-looking coating of thrush and prevent its renewal. Ringer and Sainsbury ("Hand-book of Therap.," '97).

EAR AFFECTIONS.—The astringent properties of these salts may render them useful local applications in diseases of the external ear; but, in the main, there are other better and more satisfactory remedies.

EYE DISEASES.—It is in this class of maladies that the copper salts have been mostly employed, more particularly the ammoniosulphate, sulphate, and acetate. In opacity of the cornea a solution of the first named (1 grain to the ounce of water or camphor-water) has appeared in some instances to hasten the process of absorption. A collyrium of sulphate of copper of the same strength has also been found serviceable in the purulent ophthalmia of infants. In granular conjunctivitis the pure salt in crayon form applied to the inner surface of the lids is often most satisfactory.

Copper sulphate makes a good application in purulent ophthalmia, in the form of "eye-drops," 1 grain to the ounce of water. The solid stick (blue-stone pencil) may be applied to the granulations in the treatment of granular conjunctivitis. Locke ("Mat. Med. and Therap.," '95).

MALARIAL FEVERS.—At one time the ammoniosulphate salt was in some repute as a remedy for intermittent, remittent, and tropical fevers, though on what grounds its administration was recommended is unknown. Copper salts have also been recommended in chronic malarial poisoning.

SEPSIS.—Like most metallic substances, copper has been suggested in septic disorders, but latterly its use has become very restricted.

In threatened puerperal fever good results were obtained by washing out the uterus and vagina with a 5-per-cent. solution of copper sulphate. By control experiments it was found that this salt is antiseptic and fatal to streptococci and staphylococci: the vibriones are, however, not influenced by its use. Tarnier (*Centralb. f. Gynäk.*, May 8, '91; *Archives of Gyn.*, Oct., '91).

SKIN DISEASES.—Here the value of the copper salts rests chiefly in their power as antiseptics, astringents, anti-parasitics, and stimulants. The nitrate is powerfully caustic; hence finds a place in the treatment of lupus and other stubborn maladies. The sulphate is sometimes very efficacious in tinea trycophytina, ichthyosis, and ringworm; has also been recommended in scabies, after the scabs are removed. In molluscum the crystal salt has been applied in substance with excellent results; and French practitioners often use a strong solution to remove warts.

Oleate of copper is generally efficacious to combat ringworm, and is best employed by incorporating with an equal quantity (or perhaps double its weight) of lard. It should be rubbed into the diseased surface thoroughly, and success depends upon the persistence with which the medicament is employed, as much as upon its strength. Joseph Adolphus (*Med. Age*, Apr. 10, '90).

Oleate of copper may be employed as a plaster for warts and corns. An ointment of copper oleate (1 to 4 or 8 parts of petroleum cerate) is especially useful in ringworm, if lightly rubbed in night and morning, and is recommended for the removal of freckles. Martindale and Westcott (*"The Extra Pharm."* Lond., '95).

TAPE-WORM.—A comparatively-recent application of the copper salts is as a tæniifuge.

Black oxide of copper will expel tape-worm when other remedies fail. A good combination is black oxide of copper, 30 grains, and sufficient solid extract of

gentian to make a pill mass. Divide into 30 pills, of which give 1 four times daily,—every fourth hour,—at the same time prohibiting acid food and drink during the time the remedy is taken; continue the treatment for a week if necessary. The worm will be expelled completely. Pearson (*Med. Stand.*, Feb., '92).

The following was employed with excellent results for tænia: Black oxide of copper, 3 grains; prepared chalk, 62 grains; alum, 6½ drachms; glycerin, 5 drachms; to make 240 pills; of these 8 to 12 are to be taken daily. The patient takes 2 pills daily for 4 days of the first week, and 4 pills daily for 4 days of the next week, abstaining during this time from acid food and drinks. A large dose of castor-oil is then given, when the tape-worm will be evacuated entire. Segments of the worm are passed during the two weeks of treatment. Schmidt (*Wiener med. Presse*, No. 5, '94).

TUBERCULOSIS.—In this affection sulphate of copper has been recommended on account of its emetic action. It will be recalled that half a century ago drugs of this class were held to be of value in the early stages of phthisis.

In incipient tuberculosis copper phosphate is claimed to act as a specific and dynamic agent. It may be given twice daily in pill form by adding to a suitable mass 1 grain of crystallized sodium phosphate and 1/10 grain neutral acetate of copper; or they may be given in mucilage of gum arabic; or 1/10 grain of phosphate of copper dissolved in 10 minims of glycerin may be injected subcutaneously. Bull recommends the sulphate in phthisis. Armstrong (*Foster's "Prac. Therap."* vol. i, '96).

In the diarrhoea of phthisis sulphate of copper is often prescribed, but the dose should not exceed 1/4 grain, and it is best administered as a pill made with an equal weight of opium. Murrell (*"Man. of Mat. Med. and Ther."* '96).

ULCERATIONS.—As a wash to weak, indolent, ill-conditioned, or irritable ulcers, small, excavated, semiphagedenic, and

specific, non-specific and malignant, the copper salts are valuable. The liquor cupri ammoniosulphas of the old London Pharmacopœia (1 drachm to the pint of distilled water) is an excellent preparation, as is also the Egyptian liniment (see *ante*), and a solution varying in strength according to individual demand of 1 to 10 grains of sulphate to the ounce of water. The nitrate salt is used for chancres and phagedenic ulcers in a pure state, and the sulphate is sometimes applied in powder or in solid crystal.

A powder of copper sulphate dusted over sluggish sores destroys unhealthy granulations and is a powerful local stimulant. This salt is much appreciated in veterinary practice. A lotion made of the strength of 3 grains of the salt to an ounce of water may be applied to chancres or ulcers. The nitrate, owing to its deliquescent properties, soon becomes, on slight exposure to the air, a styptic, caustic fluid, which has yielded good results when applied to syphilitic ulcerations, on the tongue, in the mouth and throat, and on the genitals. It differs from the sulphate in exciting a stronger, more healthy, and alterative action in the tissues around the ulcer after the destruction of the latter. An excellent detergent lotion is had by adding 2 minims of the liquid copper nitrate to an ounce of water. Whitla ("Pharm., Mat. Med., and Therap.," '91).

Copper sulphate makes a good application to indolent ulcers. It removes dead tissue, and by its stimulant effect promotes healthy granulations. Locke ("Mat. Med. and Therap.," '95).

DIARRHŒA AND DYSENTERY.—In chronic dysentery and diarrhœa a combination of copper sulphate and opium is often serviceable: $\frac{1}{4}$ to $\frac{1}{2}$ grain of former and $\frac{1}{2}$ grain of the latter, given thrice daily; but it occasionally induces severe griping in spite of the opiate; in such case 2 or 3 grains of monobromated camphor constitute a valuable addition.

The drug is, perhaps, most serviceable in the diarrhœa of phthisis, though some of the older authors speak highly of it in the chronic diarrhœa of infants.

Copper sulphate is a good astringent in advanced and obstinate diarrhœa. It may be prescribed as follows: Copper sulphate and powdered opium, of each, $\frac{1}{2}$ grain; extract of gentian, 3 grains; for one pill, constituting a single dose. Farquharson ("Therap. and Mat. Med.," '89).

Injected into the rectum in the strength of 5 to 20 grains to the ounce of fluid, copper sulphate will be found of service in those cases of diarrhœa which arise in the lower bowel and are dependent on ulceration. It is also sometimes given in pill form by the mouth in doses of from $\frac{1}{4}$ to 1 grain. Hare ("Pract. Therap.," '94).

UTERINE DISORDERS.—Copper sulphate is in considerable repute among some gynæcologists, particularly on the continent of Europe. It is especially employed in the treatment of catarrhal disorders.

Copper sulphate employed in 10 cases of endometritis, 7 of which were blennorrhagic in character, and 1 each puerperal, post-puerperal, and catarrhal. In all the remedy was applied locally in the form of pencils, and the results were highly satisfactory. This salt acts superficially, and does not produce the deep scars caused by zinc chloride; its effects, though less powerful, are more certain than those of the latter drug, and it does not produce atresia of the uterine canal. Annaud (Bull. Gén. de Thér., May 15, '92).

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CORNEA, DISORDERS OF THE (see also KERATITIS).—Most injuries of the cornea are of importance chiefly on account of the accompanying injury of deeper structures, such as the iris and crystalline lens, or because of the lodgment of foreign bodies, or through infec-

tion giving rise to keratitis, or more extended inflammation of the eye.

Burns.—Injuries frequently cause corneal ulcer (see below). Ultimately it may lead to corneal opacity or irregular astigmatism (see **ASTIGMATISM**). The same is true of burns, either by heat, acids, or caustics. A burn by heat or by nitric acid may cause a superficial coagulation of the corneal tissue, giving an impression of complete opacity of the membrane, but upon the separation of the injured tissue, which may occur in a few hours or at most a few days, the cornea is found to be clear and comparatively uninjured. Burns by lime are frequent, and very serious in their effects, the lime forming a union with the tissue, which makes it difficult to remove, and continuing, therefore, to act as a caustic for a considerable length of time.

Treatment.—Simple burns by steam or hot metal after removal of the metal should be treated by keeping the eyes closed under a light bandage and cleansing twice a day with boric-acid solution.

Injury by quicklime may be met by the filling of the eye with olive-oil; and especially requires the earliest possible removal of all the retained caustic. Other caustic alkalies may be neutralized by very dilute acids, as vinegar and water; but reliance should be mainly placed on washing with water or solution of boric acid.

Acids may be neutralized by lime-water, or solutions of sodium or potassium bicarbonate, or soap-suds. But the best means is by free washing of the conjunctiva with a 1-per-cent. solution of sodium bichlorate.

Foreign bodies are so frequently imbedded in the cornea because the cornea occupies nearly two-thirds of the space between the opened eyelids, and a much

larger proportion of that space when the eyes are partly closed, as they are when the entrance of a foreign body is anticipated. Again, the tissue of the cornea is of such consistence as to retain such particles as may penetrate it, whereas the conjunctiva and subconjunctival tissue are so loose that foreign bodies imbedded in them easily work out.

When a foreign body is imbedded in the cornea it commonly causes irritation and suppurative inflammation, by which it becomes loosened and easily drops out, or is wiped away by the lids. If, however, it lie at the bottom of a considerable loss of substance it may lie there for some time, although quite detached from the corneal tissue. Under these circumstances it becomes a source of irritation, causing chronic weakness of the eye, photophobia, and excessive lachrymation, and the development of vessels in the adjoining part of the pericorneal space, which push out to the seat of the foreign body, giving an appearance of a chronic phlyctenular ulcer or superficial vascular keratitis.

Among 200 cases of foreign body in the cornea 180 presented themselves for its removal within 1 week, 11 in the second week, 7 in the third week, and but 2 after more than 3 weeks. Ten cases are reported of foreign bodies retained in the cornea from 3 weeks to 18 months, and a few instances referred to in literature in which they have been retained even longer. Edward Jackson (*Brit. Med. Jour.*, Jan. 8, '98).

Cases in which the laborers employed to knock down chestnuts have been struck in the eye by the falling chestnuts and the little spines remained in the cornea, their bases, as a rule, being flush with its surface. For locating these bodies, Zehender's binocular lens, made by Western, of Rostock, are of great service, and the illumination should consist of convergent rays concentrated by a large convex lens. The prickles are

difficult to seize even with the finest forceps; Bowman's needle entered obliquely is useful. It is better to withdraw those which do not penetrate the cornea into anterior chamber before those which do. To disinfect the path of the prickle after removal, a fine tattooing needle may be rotated in the wound like a gimlet, thus scraping it, while the groove of the needle allows the antiseptic to find its way down into the wound. The galvanocautery may also be called for. Deschamps (*Ann. d'Ocul.*, Apr., '99).



Cilia in the anterior chamber. (*Meyer.*)

Diagnosis.—The search for a foreign body in the cornea should be made by all the following methods: Oblique illumination, the ophthalmoscope, and with the eye placed so as to reflect from its surface an area of light, as before a large window. If the foreign body has been imbedded many hours or days there also will be pericorneal redness, most decided at the part of the corneal margin nearest the foreign body. In using oblique illumination foreign bodies of

light color are rendered evident when the light is strongly concentrated on the cornea and the iris in comparative shadow. Dark particles are rendered distinct by concentrating the light on the iris behind, thus furnishing a light background. Light foreign bodies are best seen against the black pupil; dark ones against the illuminated iris. It is therefore necessary to vary the oblique illumination and to look at the cornea from different directions.

With the ophthalmoscope all foreign bodies except particles of glass appear black against the red reflex from the pupil. By turning the eye in different directions, this reflex must be obtained through different parts of the cornea. Sometimes with the ophthalmoscope the appearance of a foreign body is caused by a slight disturbance of the corneal surface; so, that after the position of such a black speck has been ascertained it must be examined by oblique illumination.

In young children where much difficulty is experienced in examining the cornea the child should be laid across the nurse's lap in such a way that its legs are between her body and left arm, her right hand being free to control the child's hands. The examiner sits opposite with a towel or rubber sheet across his lap and places the child's head between his knees. In this way the child is prevented from kicking and struggling, and its head is held steady, leaving the examiner's hands free to separate the lids, make the necessary examination, and apply the proper remedies. C. A. Wood and T. A. Woodruff (*Med. Standard*, Oct., 1901).

The reflection of an area of light, as a large window opening to the sky, or a strongly-illuminated card held close before the eye, is uniform from the normal cornea. But when by the presence of a foreign body the corneal surface is roughened, the irregularity caused in the re-

flection is very noticeable, and furnishes the most-readily-applicable method of recognizing the presence and location of such an injury or foreign body. If, however, the disturbance of the surface be slight, it is liable to be masked by the layer of mucus which covers the normal cornea; and to avoid this source of error the corneal surface should be dried by touching it with a bit of absorbent cotton.

Treatment.—In general, foreign bodies lodged in the cornea should be at once removed. This is usually a very simple operation with the eye placed under the influence of local anæsthesia. A single drop of a 2-per-cent. solution of cocaine, or a 1-per-cent. solution of holocain, placed directly upon the cornea produces the necessary anæsthesia in from three to five minutes. Occasionally a foreign body can be wiped away by a little absorbent cotton wrapped closely and firmly around the end of a probe or match-stick. If more firmly imbedded the ordinary spud is to be used by thrusting it into the wound alongside of the foreign body, and by something of a wedge-like action, pushing the foreign body out.

Foreign bodies of a certain character, as splinters of wood or the beards of grain or grasses, may require to be extracted as a splinter is extracted from the skin, by making an incision along it with a needle or cornea-knife, so as to freely expose it, and then lifting it out of its bed. When the foreign body extends somewhat into the anterior chamber, the eye should be kept quiet until the aqueous humor has refilled the chamber. Then a broad needle is to be thrust underneath the foreign body, and held with its point imbedded in the posterior surface of the cornea, while the foreign body is extracted.

Occasionally when the condition of the patient, or the lack of proper instruments, or of a local anæsthesia renders the extraction of the foreign body impossible, it is proper to cleanse the surface of the eye as thoroughly as possible, and allow it to remain for a few days until the process of suppuration has loosened it. Then it can be washed or wiped out. But such a process is always attended with danger of infection of the deeper structures of the eye and serious damage or complete functional loss of the organ.

Bits of iron imbedded in the cornea very quickly give rise to a brown stain, probably due to oxide of iron. This stain may remain after the removal of the foreign body, but is always cast off within a few days. It is better to remove it at once by scraping, as it often proves a source of irritation and always ultimately separates as a slough.

Study of the effects of the deposit of rust in the cornea by placing particles of iron in the corners of cuts. Five minutes were sufficient to make the iron reaction appreciable, metallic iron being chemically irritant, while iron oxide was not. The ring of rust found about the foreign body consisted of hydrated oxide of iron, and was chemically innocuous. The corneal epithelium showed itself to resist extraordinarily the invasion of the oxide of iron. Gruber (*Archiv f. Ophth. [Gräfe]*, B. 11, H. 2, '94).

Powder-grains imbedded in the cornea at first cause much irritation and inflammation. But if this has passed away the remaining stain, consisting of minute particles of carbon, may be retained indefinitely, without being a source of further trouble or danger.

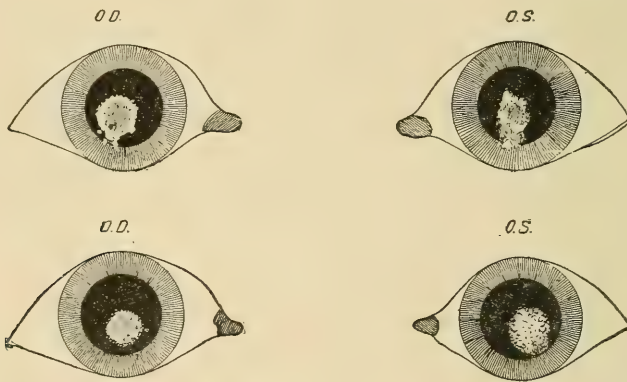
Cornea, Opacities of.

The bulk of the cornea, being a highly-specialized tissue closely related to or-

dinary connective tissue like that composing the sclera, is liable by slight degeneration to lose its transparency. All considerable injuries or losses of substance of the cornea are repaired by cicatricial connective tissue, which usually fails to become entirely transparent. Hence, corneal opacities are a probable sequel of all other diseases or injuries of the cornea. Slight haziness of the cornea is spoken of as *nebula*. A more dense localized haziness, amounting to almost complete opacity is called a *macula*. More dense and complete

Congenital opacity of the cornea is rare. It may arise from intra-uterine inflammation, or from an arrest of the clearing of the cornea, which is originally opaque. This clearing beginning at the corneal margin, such opacities usually involve the centre. They may diminish in early childhood, although this is unusual; and occasionally somewhat similar opacities are said to occur after birth and to increase.

Two cases of symmetrically-placed opacities of the cornea, occurring in mother and son. The boy was 8 years



Symmetrically-placed opacities of the cornea. The upper figures represent the appearances presented by the eyes of the mother, the lower those of the son. The pupils are represented as dilated, in order to give the configuration of the opacities against a dark background as clearly as possible. (Oliver.)

opacity, from its usual color, white, is called *leucoma*. The density of the opacity indicates the severity of the lesion causing it and the age of the patient, recovery from the severe lesions being more complete in early life.

Varieties.—The opacity usually occurring with age as a gray arc slightly within the upper and lower margins of the cornea is the *arcus senilis*. It extends in some persons to form a complete ring, *annulus senilis*, separated by a zone of comparatively-clear cornea from the sclera. Sometimes it occurs in early life; and even in early childhood.

of age, and presented in each cornea (as shown in lower portion of figure) a central macula surrounded by a ring of superficial pin-point opacities. These had been observed for a long time, but one year previously had enlarged, following an attack of malaria fever. Laveran's corpuscles could not be detected and there was no evidence of congenital syphilis. Examination of the mother's eyes showed similar opacities in each cornea, which had been present as long as she could remember. These are shown in the upper portion of the figure. Oliver (Amer. Jour. of Ophth., Aug., '92).

Record of an instance where the first, second, and fourth children of a family

were blind from congenital opacity of the cornea, most dense at the centre. There was a deep anterior chamber and rather large eyeballs. The third child had normal eyes. The mother was healthy, the father when 20 years old had suffered from inflammation of both eyes, lasting eight months; and leaving a central clouding of the cornea. Wernicke (*Ann. d'Oculistique*, Oct., '96).

Microscopical examination of the corneæ of an infant suffering from congenital opacity, dying on the third day, and without other congenital anomalies. The chief lesions were found in the posterior layers of the cornea and were allied to those of interstitial keratitis. A. Telpjäschin (*Archives of Ophthalm.*, Jan., '97).

Attention called to a form of corneal cloudiness occasionally seen in patients complaining of asthenopic symptoms rather more severe than those usually attending refractive errors. This corneal turbidity appears to be simply an exaggeration of the normal cloudiness, and can be seen with a highly magnifying lens and lateral illumination. Henry Gradle (*Phila. Med. Jour.*, July 16, '98).

Opacities due to inflammation of the cornea are most dense immediately after the subsidence of the inflammation, from which time they diminish with greater or less rapidity according to the age of the patient and the nature of the opacity. Sometimes quite a noticeable macula will be left by an inflammation occurring a few weeks previously that has been quite overlooked or forgotten. The general clouding of the cornea from interstitial keratitis clears first from the margin, and, usually in the course of several months, or one or two years, is reduced to a nebula, although perfect recovery is rare.

Peculiar greenish discoloration of the cornea following traumatism, thought to be related to corneal hæmorrhage and attributed to the presence of hæmatic pigment. Regarded as one of the accidents partly dependent upon hæmorrhage

into the anterior chamber and neighboring tissues, especially into the corneoscleral junction in front of Descemet's membrane and around the canal of Schlemm. Vossius (*Archiv f. Ophth.* [Gräfe], vol. xxxv, No. 2, '89).

Study of two cases of staining of the cornea by blood-pigment. In the first case the central part of the cornea was stained a brownish color, leaving a narrow, clear, and colorless rim at the periphery. Intra-ocular tension equaled -1, and there was no light-perception. After enucleation the discoloration of the cornea was seen to extend throughout the whole thickness. The anterior chamber was filled with blood-clots, the lens was opaque and calcareous, and the vitreous was shrunk. There was complete detachment of the retina, and projecting from its outer surface were two transparent cysts. Examination with the microscope showed that, disseminated throughout the discolored portion of the cornea, there were numerous small, refracting granules, mostly of an oval or circular form. In the second case in the centre of each cornea there was an irregular-shaped patch of a rusty-brown color, surrounded by a zone of bright red. There can be no doubt but that the pigment was derived from the blood, having found that in all the cases reported there was blood in the anterior chamber. Treacher Collins (*Transac. Ophth. Soc. of United Kingdom*, vol. ii, '91).

Opacities connected with anterior synchia remain dense throughout life. Vascular opacities connected with granular or phlyctenular conjunctivitis are capable of great improvement after the cure of the conjunctival diseases that cause them. Those due to granular conjunctivitis, or trachoma, commonly involve the upper half of the cornea, the part in contact with the roughened upper lid, and sometimes encroach slightly on the lower lid. Those due to phlyctenular keratitis take the form of a fasciculus of vessels running out from one or more parts of the corneal margin.

Anterior, or *corneal*, *staphyloma* is the bulging opacity which follows perforation of the cornea, either by traumatism or by ulcerative inflammation, leading to prolapse of the iris and union of the iris and new-formed tissue in the corneal scar. It does not necessarily ensue in all cases of prolapse of the iris into a corneal opening. After cataract extraction very extensive prolapse of the iris may occur, and yet, without any active treatment, the prolapse will in time entirely flatten down, leaving a slight opacity with adhesion of the iris at the side of the corneal incision. The same favorable termination is also seen in cases of traumatic perforation, other than operative; and sometimes in perforation due to small ulcers. The determining factor as to the occurrence of staphyloma appears to be the general condition of the cornea, and possibly of the iris, that becomes adherent to it. If these are the seat of extensive inflammatory changes, there is strong probability of increasing bulging of the cicatrix.

In young children the general adhesion of the iris to the cornea is followed by bulging of the whole cornea and even great enlargement of the eyeball; in older persons staphylomata are likely to be more strictly localized, and, if the bulging is great, they rupture.

Fine opacities upon the membrane of Descemet can be seen in all cases of iritis. They are usually overlooked, because the required examination is not made. The best method of examination is with the ophthalmoscope, a strong convex lens being used at the sight-hole. Such deposits appear early in iritis, frequently before synechiæ have been formed, and they disappear some time after the inflammation has subsided. Larger opacities are found in many cases. An irregular striated opacity of the cornea also attends certain cases of

iritis, this opacity being situated in the proper corneal substance. H. Friedewald (*Archives of Ophthalmology*, April, '96).

The binocular magnifying lens not only allows the surgeons to discriminate by accurate recognition of the depth of a corneal opacity, but by its binocular impression causes points to be appreciated that would otherwise not attract the attention of the observer. E. Jackson (*Trans. of Section on Ophthalmology, Amer. Med. Assoc.*, '97).

Opacity following the use of a lead lotion upon an ulcerated cornea has long been recognized and ascribed to the deposit of metallic lead in the denuded corneal tissue. But this explanation is now shown to be incorrect, for at least some of these cases.

A case of corneal ulceration was treated with iodoform ointment, but no preparation of lead was used. The lower half of the cornea presented a white metallic appearance like that ascribed to the use of a lead lotion. Darier (*Rev. Gén. d'Ophtal.*, July 31, '96).

Iodine-vasogen is a valuable application in infiltrated and spreading ulcers of the cornea, whether associated with purulent conjunctival secretion or not. It is particularly indicated in those cases in which the galvanocautery is contra-indicated by the situation of the infiltrate. It rarely causes pain, if not applied in excess, and never causes any unpleasant reaction or untoward effects. Preliminary anæsthetization of the cornea with cocaine is rarely required, and in general is better omitted. The application is best made every other day until the infiltrate begins to shrink decidedly, and then should be made every three or four days until the infiltrate disappears. Alexander Duane (*Archives of Ophthalmology*, vol. xxxi, No. 5, 1902).

Opacity from pigment-deposit in the cornea is of two kinds. In one, small spots of black or brown pigment are de-

posited in the cornea, late in the history of an intra-ocular inflammation which has usually been attended with high tension. Such pigment-deposits are likely to be permanent. A temporary general staining of the cornea by blood-pigment occurs after extensive hæmorrhage within the eyeball. The staining is at first comparatively uniform, and clears up from the margin of the cornea.

An acute glaucoma of eight weeks' standing had been treated with iridectomy, which was followed by a hæmorrhage filling the anterior chamber. When the hæmorrhage was absorbed and the cornea cleared up, pigment-masses were noticed near the centre of the cornea and below it. These had their origin in dots of gray opacity, which were seen to become pigmented, and change in color from gray to brown and black. C. A. Wood (*Annals of Ophth.*, Apr., '96).

An extensive prolapse of the iris through wound of the eye by scissors was removed by iridectomy. This was followed by repeated hæmorrhages into the anterior chamber, and subsequently the patient, a girl of 3½ years, had measles. There was marked discoloration of the cornea beginning the tenth day after operation, and increasing until the membrane assumed a greenish-brown color, except near the corneal margin. At the end of fifteen months the blood-staining of the cornea had cleared up except at the centre, where there was an oval patch of brownish hue with sharply-marked edges; and this part had also become translucent. G. E. de Schweinitz (*Ophthal. Record*, Dec., '97).

Haziness of the cornea due to inflammatory deposit tends to clear up at first rapidly and then more slowly after the subsidence of the inflammation causing it. This tendency to clear up may be accelerated, or continued after it would otherwise cease, by certain applications to the cornea. One of the oldest, the dusting of calomel upon the surface, is

still useful in the opacities left by phlyctenular keratitis. Other irritants have been used in a similar manner. Massage of the cornea, either by rubbing through the closed lid, or by stroking and rubbing the cornea with a corneal spatula, or specially devised instrument, has also a positive effect in renewing the process of absorption when this becomes sluggish. Electrolysis is also of marked value in clearing up such opacities, if they are unattended with anterior synechiæ, and especially if due to infiltration of the cornea rather than repair of extensive loss of substance by ulceration.

When it is impossible to secure further absorption of the opacity, it may be rendered less noticeable and annoying by tattooing the affected region.

[L. de Wecker insists that tattooing for optical purposes should be recognized as distinct from tattooing merely to improve the appearance of a sightless eye. He believes that, by rendering opaque the semitransparent corneal tissue in front of the pupil, the diffusion of light can be diminished and the acuteness of vision improved. Tattooing for this purpose may require to be combined with optical iridectomy or the division of the sphincter of the iris. In performing the operation the area to be tattooed must first be distinctly marked out, and then must be colored a uniform intense black. EDWARD JACKSON.]

Iridectomy should not be performed for optical purposes in children whose corneas are opaque; yellow ointment should be used, followed by massage through the closed lids for thirty seconds, the eye being washed afterward with boric-acid solution. This treatment is repeated daily until the eye is injected, and then discontinued, to be renewed when the irritation disappears. Of 112 children with leucomas of different extent and depth, 91 were cured, 11 improved, and 10 did not continue treatment. I. Malgat (*Rec. d'Ophthal.*, Mar., '98).

Tattooing of the cornea should not be entered upon too lightly. One should refuse to operate in any case in which the iris is incorporated in the cicatrix. Trousseau (*Ann. d'Ocul.*, Mar., '99).

Dionin used to clear up new and old corneal opacities. The solid drug is applied in doses of about 0.005 gramme ($\frac{1}{10}$ grain) once, or rarely twice, a week to the conjunctiva. In this way there is not acquired that speedy tolerance to its action. The pain lasts from two to five minutes; the œdema reaches its height in fifteen or twenty minutes, and lasts from four or eight to twelve hours, or even longer. Sneezing is a common sequel, especially in adults. In those cases where the patient must be treated at home an ointment containing 10 per cent. of dionin is ordered, with directions that a small mass should be placed inside the lids and then gently rubbed. In five cases, among sixty in all, no œdema resulted. F. R. v. Arlt (*Wochen. f. Therapie u. Hygiene des Auges*, Dec. 11, 1902).

Cornea, Tumors of.

New growths situated wholly or chiefly in the cornea are rare. They may be of importance because of the disfigurement they produce from interference with vision or by danger of extension when of a malignant character.

Frequently tumors of the conjunctiva extend over the cornea, and so belong partly to both regions. It has even been doubted whether primary tumors of the cornea ever occur. But well attested cases are on record. The most frequent form of corneal tumor is the dermoid, which usually starts about the sclero-corneal junction and extends both ways. It is generally believed to be always congenital; but may slowly increase in size for many years; such tumors are commonly removed for cosmetic reasons.

Such tumors may be located on the cornea alone or on the sclerotic alone, but the largest number involve both,

being found most frequently at the outer and lower sclero-corneal margin. They are all congenital. A. R. Baker (*Trans. Sec. on Ophth., Amer. Med. Assoc.*, p. 97, '96).

Malignant neoplasms involving the cornea are usually secondary.

Perhaps carcinoma of the cornea is always secondary to such growths of the conjunctiva or some more distant part. Fibroma or sarcoma may be primary.

Report of a case of fibroma removed from the cornea of a woman, aged 50, where it had been slowly growing. The margin of the cornea, about one millimetre wide, was transparent all around. The tumor was flat, whitish, and two millimetres thick. It was easily dissected from the cornea, which was transparent, and its removal allowed the patient to read large letters. The microscope showed it to be purely fibrous, and derived probably from the corneal substance. D. Meigham (*Glasgow Med. Jour.*, vol. ii, p. 223, '96).

Report of a case of primary sarcoma commencing at the corneal limbus. Twenty-two other cases found in literature. From a study of these, conclusion reached that sarcoma of the limbus is comparatively rare and remains confined to the external structures. Metastases practically never occur. Recurrences are frequent, but do not justify enucleation, unless the growth has attained extensive proportions or vision has been destroyed. A. N. Strouse (*Archives of Ophth.*, p. 217, '97).

Corneal scars, although often permanent, and, if large, subject to distension, very rarely become the seat of keloid changes. But a tumor of that kind is possible.

A girl suffered from ophthalmia neonatorum, which left the cornea opaque. For six months the scar did not change, and then it began to grow. At two years it looked like a large staphyloma, but when examined under anæsthesia was found to be a large tumor. On removal it was found almost eight millimetres

thick. A microscopical examination showed it to be chiefly keloid. Two similar cases had been previously reported by Simon and Szokalski. C. D. Westcott (Annals of Ophthal., p. 472, '97).

EDWARD JACKSON,
Denver.

CORN-ERGOT AND CORN-SILK.—

The Indian corn or maize (*Zea mays*) yields two medicinal substances: one when the plant is diseased with smut, the other only when in a healthy condition.

Ustilago maydis is a fungus growth: the ergot of corn, in fact. It occurs in globose masses, irregular, three to six inches thick, made up of nodular and globular, brownish-black spores inclosed in a blackish membrane. Its taste is unpleasant and its odor disagreeable. There is contained a volatile alkali, a fixed oil, and principle analogous to sclerotic acid.

Stigmata maydis, or "corn-silk," is the green pistils of maize-plant: a cereal that, though indigenous to North America, is now well known in all quarters of the civilized globe. The pistils are of value only after they have shed their pollen.

Preparations and Doses.—Corn-ergot, powdered, 10 to 60 grains.

Corn-ergot, fluid extract, 10 to 60 minims.

Corn-silk, fluid extract, 1 to 2 drachms.

Corn-silk, infusion (1 to 8), *ad libitum*.

Corn-silk, syrup, 1 to 4 drachms.

Corn-silk, wine, 30 to 60 minims.

Physiological Action.—The action of corn-ergot appears to be relatively the same as that of ergot of rye, except that the contractions induced by the former are regularly intermittent, and those provoked by the latter are tonic. Corn-ergot by many is held to be quite as

efficient and more uniform than its rye congener.

Corn-silk augments the secreting power of the kidney, and is likewise tonic to the secretory membrane; thus it is both diuretic and demulcent, and perhaps possessed of some antilithic power. Its diuretic action, if given in full doses, is both mild, certain, and rapid, whereby a debilitated kidney is not only relieved, but also an overburdened circulation: the pulse becomes more regular and the arterial tension stronger. It has no disturbing effect upon any organ; hence its tolerance is complete; and it can be taken for weeks without inconvenience of any kind. Some French authors assume it to be locally anodyne or anæsthetic, and to possess a peculiar elective action on the tissues of the ureter and bladder. It certainly is, in some degree, both antiseptic and antilithic.

Therapeutics.—The therapeutic properties of *ustilago maydis* may be said to be those of ergot, but to a milder degree. The claim has been made that, employed subcutaneously, corn-smut is superior to that of rye in the treatment of uterine fibroids, but this lacks confirmation.

GENITO-URINARY MALADIES.—Corn-silk is serviceable in all inflammatory conditions of the genito-urinary apparatus, acute or chronic, idiopathic or traumatic. It is especially valuable where intravesical decomposition of urine has given rise to irritation; and it may with advantage be combined with other antilithics in the treatment of gravel, etc.

CORYZA, ACUTE. See NASAL CAVITIES.

COTTON-PLANT.—*Gossypium herbaceum* is a plant indigenous to the trop-

ical and subtropical regions of Asia and Africa, and that by transplantation has become a native of the western hemisphere. It has long, petiole, palmate, three- or five-lobed leaves of a green or dark-green color; the flowers are yellow. The bark of the root occurs in thin, flexible bands or quilled pieces, the outer surface brownish yellow, with slight, longitudinal ridges or meshes; small, black, circular dots; and dull, brownish-orange patches from the abrasions of the thin cork; inner surface whitish, of a silky lustre, and finely striate; bast-fibres long, tough, and separable into papery layers; inodorous; taste slightly acrid and astringent; seeds oblong or ovate, pointed at one end and covered with silvery-white hairs.

Preparations and Doses.—Cotton-root abstract, 3 to 15 grains.

Cotton-root extract, solid, 2 to 10 grains.

Cotton-root extract, fluid, 30 to 120 minims.

Cotton-root decoction (1 to 10), 4 to 16 drachms.

Cotton-root bark, powdered, 20 to 60 grains.

Cotton-root tincture (1 to 4), 1 to 4 drachms.

Cotton-seed extract, solid, 5 to 15 grains.

Cotton-seed oil, 2 to 16 drachms or more.

Cotton-leaves, tincture (expressed juice of fresh leaves, 1; proof-spirit, 8), 10 to 60 minims.

Gossypin (concentration), 1 to 5 grains.

Physiological Action.—Cotton-root bark is emmenagogic, oxytocic, ebolic, and deobstruent. Its action is practically identical with that of ergot. It is safer than the latter, and operates

without pain, but is not so active, especially during parturition. It also requires to be given in larger doses, and may be exhibited with impunity even in the first stage of labor. A decoction of the fresh root is more active than either the tincture or fluid extract.

The juice of the fresh leaves seems to exert a tonic alterative action on the intestinal tract, very like that of coto and paracoto, but less pronounced.

Cotton-seed oil is a *succedaneum* for olive-oil; it is bland and nutritious, also slightly expectorant, markedly galactagogic and aphrodisiac. An extract made from cotton-seed exhibits these properties in greater or less degree.

Therapeutics.—The therapeutic indications are the same as for ergot as regards preparations of the root. The fresh leaves are employed internally in dysentery and diarrhoeas, externally to inflamed joints, the breasts of nursing women to promote the secretion of milk, and to boils and abscesses to hasten their maturation. Cotton-seed oil finds its chief use in the preparation of liniments.

PARTURITION.—Cotton-root bark is mild and certain in action, and does not produce the well-known, rapid convulsive action of ergot; but, on the contrary, seems to greatly stimulate the uterus to normal function. It acts not alone upon the uterine muscles, but also upon the secretory function.

Gossypin represents the emmenagogic and parturient principle of cotton-root bark; but, unfortunately, as generally found in shops, owing to improper methods of manufacture, is seldom to be relied upon.

COW-POX. See VACCINIA.

COXALGIA. See HIP-JOINT.

COXITIS. See HIP-JOINT.

CREASOTE.—Commercial creasote is obtained during the dry distillation of wood-tar, or from crude pyroligneous acid. Medicinal creasote is, or should be, obtained from the distillation of the tar of the beech (*Fagus sylvatica*). The substance is exceedingly complex, being a mixture of phenols, chiefly guaiacol and cresol.

Pure creasote is a colorless, oleaginous liquid of burning taste and possessed of a disagreeable penetrating, smoky odor that is most characteristic. Its specific gravity is 1.080, but much of that sold as pure creasote will be found to vary from 1.035 to 1.085. With age it acquires a yellowish hue, and if continuously exposed to light and air it becomes of a deep-reddish brown, when it is unfit for medicinal use. It is but sparingly miscible with water, perhaps 1 to 130 up to 150, but is soluble in all proportions in alcohol, ether, petroleum-spirit, and glacial acetic acid. It is often substituted for by crude phenol, to which it is intimately related, both chemically and therapeutically. The fraud may be detected by the simple fact that the latter is soluble in glycerin, while creasote is not. Again, creasote does precipitate nitrocellulose from collodion, and gives a green reaction with a weak alcoholic solution of ferric chloride; phenol gelatinizes collodion and, with the iron test, yields a brown reaction.

Creasote is incompatible with strong mineral acids, and reduces some of the metallic salts,—silver nitrate, for instance. With silver oxide, explosion and deflagration result.

Preparations and Doses.—Creasote (pure beech-wood), 1 to 3 minims.

Creasote benzoate, topical use only.

Creasote carbonate (cresalol), 5 to 20 minims.

Creasote - calcium chlorohydrophosphate, 3 to 8 grains in emulsion.

Creasote codliver-oil (creasote, 15; codliver-oil, 1000 parts), 1 to 4 drachms.

Creasote elixir (creasote, 15; rum, 1000 parts), 1 to 4 drachms.

Creasote ointment, simple (creasote, 1; simple cerate or other fat base, 8 parts).

Creasote ointment, *fortior*: used for psoriasis and skin diseases of like character only (creasote, 60 grains; yellow wax, 30 grains).

Creasote oleate (oleocreasote), 20 to 120 minims).

Creasote pills (creasote and curd-soap, of each, 120 grains; make 2-grain pills), 1 to 3.

Creasote valerianate, 2 to 10 minims.

Creasote-water (creasote, 10; distilled or flavored water, 990 parts), 1 to 4 drachms.

Creasol, 5 to 10 grains.

Cresol, external use solely.

Creasol iodide (Iosophan), external use.

Cresol-salicylate (cresalol), 2 to 10 grains.

Cresotic acid, disinfectant only.

Guaiacol (liquid), 2 to 5 minims. See **GUAIACOL**.

Guaiacol benzoate (benzosal; benzoyl-guaiacol), 4 to 10 grains.

Guaiacol biniodide (deuto-iodide), 1 to 3 grains.

Guaiacol-carbonate, 3 to 8 grains.

Guaiacol-phosphate, 2 to 8 grains.

Guaiacol-salol, 5 to 15 grains.

Cresol, meta-, ortho-, para-, are disinfectants only.

Paracreasote of sodium, 1 to 15 grains. See **SODIUM**.

Paracreasotic (creasotinic) acid, 10 to 40 grains.

Creasote carbonate, or cresolal, is a light-brown, viscous liquid, almost odorless and tasteless, insoluble in water, but soluble in oils; it contains carbonates,

guaiacol and cresol, and is employed as a substitute for creasote proper. It is generally stated that it may be administered in large doses for a lengthened period without untoward result—that it will not in any way disturb the economy, no matter what the amount ingested; but this must be taken *cum grana*, since it is based solely upon the *dicta* of interested manufacturers and purveyors. Besides, it is contrary to the rules of evidence.

Creasote-calcium chlorohydrophosphate forms a white, syrupy mass, but presents no advantages over creasote.

Creasote oleate, or oleocreasote, also known as creasote-oleic ether, is obtained as a yellowish, oily liquid of a specific gravity of 0.950 at 59° F., soluble in ether, chloroform, and benzene; consequently it can only be administered in emulsion.

Creasote valerianate possesses about the same value—at higher market-price—as creasote carbonate, but is supposed to combine also the effect of valerianic acid, though this must necessarily be universal.

Creasol is obtained by heating beechwood creasote with tannic acid and phosphorus oxychloride. It is a dark-brown, very hygroscopic powder, with creasote odor and taste, soluble in water, alcohol, glycerin, and acetone; and insoluble in ether. It is held to be astringent and antiseptic.

Cresol, which is merely an antiseptic for external use, differs from creasol in that it is a yellow, aromatic liquid possessed of a vanilla-like odor.

Cresalol, paracresalol, or paracresylic ether of salicylic acid, is a condensation of salicylic acid with paracresol, whereby is obtained a whitish, crystalline powder or white needles. It is insoluble in water, but freely soluble in alcohol and ether,

and melts at about 39° or 40° F. It was introduced as a substitute for salol, but seems not to have received any great confidence on the part of the medical profession.

For “guaiacol” see GUAIACOL, vol. iii.

Creasotic, cresotic, or paracresotic acid—the paracresol of French authors—is a homologue of salicylic acid, and is obtained in long, white, prismatic needles that are soluble in alcohol, ether, and chloroform. In minute doses it is employed as an antiseptic, in larger doses as an antipyretic. The maximum dose during twenty-four hours is 60 grains.

Creasotinic acid, also known as oxytolutic or homosalicylic acid, is the same as the foregoing; is also obtained as an ortho-, meta-, or para- modification; hence is frequently designated in the plural as “creasotic acids.” The para compound only finds place in medicine, but its place for the most part is usurped by its sodium salt.

Creasote is largely administered in pillular form, which, however, is objectionable for two reasons: First, no suitable excipient is known. Second, creasote pills are variable in strength and by no means stable, besides being nauseous.

Examination of nine commercial samples of creasote pills made, employing one hundred of each sample. The variations were as follow:—

	Amount of creasote claimed.	present.
I.....	5.00	4.92
II.....	2.50	2.30
III.....	10.00	9.60
IV.....	5.00	4.70
V.....	5.00	1.65
VI.....	5.00	2.25
VII.....	5.00	3.14
VIII.....	5.00	4.30
IX.....	5.00	4.70

Beckurts (Apoth. Zeit., '96; Med. Age, Nov. 25, '96).

In prescribing creasote it must be borne in mind that the ordinary commercial article is derived from pine, and unfit to be employed medicinally, except, perhaps, topically. Medicinal creasote is always understood to be the beech-wood product.

Undoubtedly the best method of administration is in some fluid—in cod-liver-oil, in emulsion, in elixir, or as combination of the elixir and codliver-oil.

An emulsion may be prepared by making two solutions—one equal parts of alcohol and creasote, the other equal parts of water and saccharate of casein—and shaking together. This should then be diluted with water, in the proportion of 1 quart to 10 drachms of the emulsion. The dose is 1 drachm mixed with milk or from 3 to 4 ounces administered by enema. Léger (*L'Union Pharm.*, July 15, '93).

A palatable mixture is the following: Creasote and glacial acetic acid, of each, 15 minims; spirit of juniper, 30 minims; syrup, 1 ounce; distilled water, 15 ounces. The dose is 1 to 2 ounces. Whitla (*"Pharm., Mat. Med., and Therap."* '92).

It has been proposed to administer creasote in "enteric coated" pill,—*i.e.*, a pill that will only dissolve in intestinal fluids; but such pill coating is theoretical only, and all those that have been exploited have proved failures. They are based upon the assumption that the normal intestinal secretions are invariably acid, which is far from being true; indeed, the opposite is the fact.

Hypodermic Use.—Formerly creasote was employed subcutaneously only when added to other remedies to preserve the solution. An old formula was 10 grains of morphine in 60 minims of creasote, of which the dose was 6 minims, but its injection was extremely painful and produced an elevation of the skin resulting in a yellow pustule which, though it subsided on the second day, was succeeded

by sloughing, redness, infiltration, and thickening. Only sciatica could justify this measure. But, when the drug began to be employed for phthisis, the following found favor among French practitioners:—

℞ Dried pepsin, 20 grains.
Morphine muriate, 1 grain.
Beech-creasote, 6 minims.
Glycerin (neutral), 154 minims.
Alcohol, 20 minims.
Water, enough to make 224 minims.

Dose, 16 minims, five or six times daily, injected deep into the muscular substance. The morphine is often left out, its sole purpose being the obtunding of the pain that supervenes after the operation. On the whole, however, creasote hypodermically possesses no advantage over the oral administration.

Physiological Action.—Topically, creasote is caustic, antipruritic, analgesic, astringent, and markedly antiseptic and germicide. Taken internally, in small doses it is expectorant and a cardiac and nerve-stimulant; besides, it is cooling and sedative to the stomach, from which it is readily absorbed into the circulation and then diffused with great celerity; it is styptic, increasing the coagulability of the blood. Larger doses depress the heart and nervous system, but accelerate respiration and render it full, with perhaps a secondary result which entirely reverses the order; it stimulates the vagi both at the periphery and centre. It is eliminated chiefly by the kidneys and lungs. Its beneficial effects cannot be attributed to any antibacillary action, since it does not diminish the number of the bacilli of tuberculosis nor even diminish their virulence.

Creasote is eliminated by the kidneys no matter how administered, and the largest amount thrown out is during the

first twelve hours after administration. The elimination by the lungs is comparatively insignificant. The guaiacol element appears to be most rapidly eliminated. Imbert (Nouv. Montpellier Méd., '92; Ther. Gaz., Mar., '92).

The favorable action of creasote is due to (a) bactericidal action on the microbes which accompany the bacillus of Koch; (b) to its stimulating action on nutrition, so that phagocytes which prey upon the tubercle bacilli are increased in number; and (c) to its chemical action on the toxins excreted by bacilli. Savine (Academy of Medicine, July, '98).

Poisoning by Creasote.—When toxic quantities are ingested, the heart and circulation are powerfully depressed, the temperature is lowered several degrees, the pupils are minutely contracted, and respiration is paralyzed. This is also the case with the vasomotor centre of the medulla; there is first vertigo, later stupor. Owing to stimulation of the anterior cornu of the cord, muscular tremblings and even convulsions may supervene.

Some persons seem very sensitive to the action of creasote, while others appear to tolerate it in enormous doses; hence the problem of elimination should be taken into account on all occasions where the drug is prescribed.

Two cases of pulmonary tuberculosis treated by rectal injections of creasote 30 minims daily. The urine soon became black, though clear when first passed, and resembled that excreted in carbolic acid poisoning. Even after the substitution of guaiacol for creasote, one case continued to pass urine that became black. Nimier (L'Union Méd., Aug. 31, '95).

Case of a man, aged 35, suffering from phthisis pulmonalis, who commenced to use creasote in doses of 1 minim thrice daily, and rapidly increased the same until he was ingesting exactly 340 minims every twenty-four hours. During two and one-half months he continued to take 3 and 4 fluidrachms daily, and then he reduced to 140 minims,

which he still continues. He has never experienced any ill effects. Graham (Brit. Med. Jour., Jan. 15, '98).

Result of six experiments on dogs: 1. Creasote, 1 to 625 body-weight, caused death in twenty minutes. The necropsy showed acute gastro-enteritis (stomach strongly corroded and small intestines markedly inflamed), and pulmonary oedema from cardiac paralysis. 2. Creasote carbonate, 1 to 3165 body-weight, did not give rise to the slightest disturbance. 3. The same dog on the following day received creasote carbonate, 1 to 600 body-weight, but presented no abnormal symptoms beyond hebetude. 4. A dose of the same, 1 to 500 body-weight, gave no results. 5. Guaiacol, about 1 to 1000 body-weight, gave rise to uncertainty in hind-legs, falling, vomiting, trembling, especially of the limbs, and sluggish pupils. The vomiting continued, with noisy respiration, watery discharge from the mouth, and later subnormal temperature, slow respiration, and slow pulse were observed. Death followed in about seven hours from the administration of the drug. The necropsy showed acute gastro-enteritis (marked inflammation of the gastric and upper portion of the small intestine and swelling of the remainder) and pulmonary oedema from cardiac paralysis. 6. Guaiacol carbonate, 1 to 500 body-weight, caused no results. 7. The same, 1 to 380 body-weight, also produced no result. In conclusion it can be stated that both creasote and guaiacol in large doses are poisonous, and cause death through their corrosive action, and, *per contra*, creasote and guaiacol carbonates, even in large doses, have no influence upon the system. W. Hesse (Deut. med. Woch., No. 5, '98).

Stertorous breathing; cold, clammy skin; pinched face, anxious expression, abolition of reflexes; weak, thready, and often imperceptible pulse; feeble respiration, and, above all, the odor of the drug are the prominent symptoms of poisoning. Death occurs from failure of respiration, and the heart is arrested in diastole.

According to the Bulletin of Pharmacy for December, much of the commercial article sold as "creasote" is not the creasote intended by the "Pharmacopœia," made from beech-wood, but is instead liquefied carbolic acid made from coal-tar: a distinctly poisonous article not to be administered for the purpose for which true creasote is indicated. In prescribing this drug the physician should be careful to specify the official article, unless he is satisfied that the prescription will be filled by a pharmacist who submits all of the drugs he dispenses to pharmacopœial tests. Editorial (Penna. Med. Jour., Dec., 1902).

Treatment of Poisoning.—If seen in time, the stomach should at once be washed out. Epsom salt, demulcent drinks, heat to body and limbs, and atropine and strychnine hypodermically are indicated; coffee, digitalis, and opium for the relief of pain, are often demanded. Soluble sulphates have been credited with powers as antidotes.

Derivatives.—The creasote preparations and derivatives differ little from the drug itself as to physiological action. Most have been exploited on the score of greater palatability or as being less noxious, but the evidence as regards the latter rests upon a very slender foundation. Creasol is more astrigent, and creasote carbonate more palatable.

Creasote carbonate is better borne than ordinary beech-wood creasote. It has, in many cases, a tendency to diminish secretion; it seems to have no influence upon peristalsis. Occasionally it excites fluid stools, but these vanish in one or two days and normal evacuations succeed; occasionally it appears to induce costiveness. There is no unpleasant action on the stomach: eructations and vomiting are rare, and only appear after large doses have been ingested, and even then rapidly disappear without withdrawal of the remedy. It increases appetite, diminishes and deodorizes the secretion of lung and kidney, and exerts generally a favorable effect upon nutrition. Reiner (Ther. Woch., Jan., '96).

Paracreasotic or creasotinic acid has been employed along the same lines as creasote carbonate.

No marked effect is produced upon the healthy human organism by doses of 40 to 60 grains, with the exception of a feeling of great fullness of the blood-vessels of the skin, a light pulsation of the arteries, and a moderate perspiration. No influence is exercised on the digestive functions. In some cases, however, the drug induced collapse and erythematous eruption. As a rule, children bear the drug well. Thus, in a boy, 12 years old, 15 grains were given every five hours, and even larger doses produced no after-effects. The temperature was reduced 2 degrees. Demme (Wiener med. Blatt., Apr. 15, '90).

Cresotic (not Creasotic) Acids—Para- and Ortho.—A proposal to utilize these chemical compounds as remedies for internal administration, led to a study of their effects. These seem to centralize upon the spinal cord.

The fatal dose of paracresotic acid is about 3 grains per pound-weight of animal; double this killed a rabbit of 2½ pounds in three hours, and 12 grains, in the same time, one a pound heavier. One grain of the ortho-acid per pound of body-weight is sufficient to cause death in from twelve to thirty-six hours, this being preceded by symptoms of paralysis, especially of forelimbs. A combination of both drugs resulted in increased poisonous properties. Charteris (Brit. Med. Jour., Mar. 28, '91).

Therapeutics. — **GASTRO-INTESTINAL DISORDERS.**—In vomiting, gastrodynia, nausea, etc., creasote is a remedy of great power and an excellent rival of hydrocyanic acid. Even in the vomiting attendant on malignant disease of the stomach, duodenum, liver, or pancreas, it is often most effective, though the relief afforded is necessarily but temporary. In the diarrhœas of children and infants, especially those peculiar to the heated term, it is of great utility, and not infrequently it serves a most excellent purpose

in the management of tropical diarrhoea and dysenteries.

HÆMORRHAGES.—Here the drug has been employed with great advantage, both topically and internally. Few remedies are so valuable in hæmoptysis, in hæmatemesis, hæmaturia; it is invaluable in the washing out of bladder, intestinal hæmorrhages of continued fever, etc. In superficial bleedings from wounds, leech-bites, after the extraction of teeth, the topical application is almost magical in results; and the late McCormack, by its aid, once arrested hæmorrhage from the carotid artery. Though there is no definite record of its use in cases of hæmophilia, such would seem to have definite basis, though from a palliative rather than remedial standpoint.

DIABETES.—It has been observed when this drug is administered in small doses, thrice daily, in diabetes, gradually increasing by 1 drop every alternate day until the point of toleration is reached, that it has a very beneficial action on diabetes; but aperients should be frequently employed in order to assist elimination by the bowels. Usually the urine is much improved in quantity and character, and there is frequent micturition.

Creasote, when administered internally, is of considerable value in the treatment of diabetes mellitus. In two cases 4 drops were given daily, and gradually increased 10 minims, under which the sugar gradually disappeared from the urine, and even a return to starchy food did not cause any reappearance of saccharine matter. Valentini (*Les Nouv. Remèdes*, Mar. 8, '91).

VENEREAL DISEASES.—In gonorrhœa, blennorrhœa, gleet, etc., especially the chronic stage of the former, creasote is often of greater benefit than cubebs, copaiba, santal-wood oil, and the like, and it may be employed both by the mouth

and by urethral injection. It is especially available in gonorrhœa of the female; in leucorrhœas, etc., and as a wash and gargle to syphilitic lesions of all forms, especially specific ozæna.

Fifty cases of gonorrhœa in the male that were successfully treated with injections of emulsion of creasote, 2 to 10 per 1000. The discharge quickly decreased, became mucoid, and then ceased altogether. The patients recovered more rapidly than under ordinary methods and without a single complication or relapse. The creasote seems to exercise an anæsthetic action on urethral mucous membrane. Larska (*Med. Oboz.*, '96; *Med. Age*, Jan. 25, '97).

CYSTITIS.—Inasmuch as creasote and its derivatives when administered by the stomach tend to prevent decomposition of urine, it has been suggested they may prove useful in cystitis, enlarged prostate, and paralyzed bladder.

SEPTIC DISEASES.—The value of the drug in the management of all forms of sepsis cannot be too highly extolled. It is one of the very few agents that make an impression on glanders in the human subject, and it is even more effective in anthrax, puerperal fever, carbuncle, etc., and may be employed both internally and topically.

It has also been employed, locally and internally, in erysipelas, including the phlegmonous form, in phlegmasia dolens, and puerperal fever. In idiopathic erysipelas it should be applied pure, or sufficiently strong to render the cuticle white immediately it is touched, and penciled over the whole of the inflamed surface, even beyond it. In the phlegmonous form the applications should be more frequent, and compresses soaked in weak alcohol (in which a little creasote may be dissolved) kept constantly applied.

SKIN DISEASES.—Creasote long en-

joyed considerable celebrity as a remedy for lepra, psoriasis, impetigo, acne, prurigo senilis, ephelis, tinea in all its forms, sycosis, and scabies, but of late years it has been little employed, owing, in part, to its disagreeable odor and the difficulty encountered in securing a pure product, and partly to the fact that its place has been usurped by carbolic acid. The stronger creasote ointment (creasote, 1 drachm; yellow wax, 30 grains) is more especially intended for use in lepra, psoriasis, and tinea trichophytina, but should never be applied to the face, the neck, the abdomen, or the flexor surface of the limbs.

ULCERATIONS.—Non-specific sloughing and phagedenic ulcerations are often greatly benefited by the stronger ointment of creasote, or even by pure creasote, locally applied; they become clean, and long-standing ones heal rapidly. To indolent and mild ulcers, weak solutions, or the elixir may be applied; the same appears efficacious in the management of bed-sores, and it has even been claimed that sponging with a 1 to 80 lotion will prevent their formation.

As stimulants, antiseptics, and escharotics, applications of creasote are often made which range in strength, according to the severity of the case and the sensitiveness of the part, from 1 drop to 1 ounce of water, up to the pure drug. Thus are treated a large number of morbid conditions, among them indolent and sloughing ulcers, fistulæ, gangrenous surfaces, leucorrhœa, puerperal metritis, fœtid otorrhœa, diphtheria, burns with excessive suppuration and redundant granulations, and chilblains, and to wash out the pleura in cases of empyema.

Ulcers of the larynx, whether tubercular or not, may be treated by the application of creasote, and a solution containing 1 or 2 drops of creasote to 1

ounce of water is useful as a stimulating and disinfecting gargle.

TUMORS and EXCRESCENCES have been treated by the local application or injection of creasote, with more or less success, yet there are so many remedies of more pleasant character that the method has been practically abandoned.

PULMONARY DISEASES.—It is in diseases of the respiratory tract that the remedy has gained greatest repute in late years. Inasmuch as it is eliminated by the bronchial mucous membrane, which it stimulates, it is an expectorant of great value, especially so if there be any fœtor of the secretion. In full doses it is the most valuable of all remedies in chronic basilar cavities. It is strongly recommended in pulmonary, laryngeal, and abdominal tuberculosis, and there is little doubt that it is one of the best agents yet introduced for the treatment of ordinary phthisis and of bronchiectasis, bronchorrhœa, broncho-pneumonia, and some forms of bronchitis. The greatest drawback to the use of the drug is the inability of many patients to take it in doses sufficient, either as to amount or to their continuance, to be of benefit. The different modes of administration that have been advocated, except that by the mouth, are all objectionable; the rectum is even more intolerant than the stomach, and after a few days the patient loses control of the bowel and is frequently attacked by colic and diarrhœa. With subcutaneous injections, the risk is run of inducing gangrene or abscess, and the pain is not alone considerable, but often excruciating. Injection into the trachea, which has been suggested, has not as yet been sufficiently tried to warrant more than a mention. The subject will be taken up exhaustively when the various forms of pulmonary phthisis are studied.

Intratracheal injections of creasoted oil (1 to 20) are admirably borne by the majority; 30 minims may be employed twice daily. No complications are provoked, and the patients never had hæmoptysis, fever, stitch in side, or digestive trouble. Experiments showed that the oil reached the alveoli, and stayed there fifteen days. The injections should be practiced during many months, and it is necessary to auscultate the patients frequently and make them take a position that will allow the oil to penetrate to the diseased portions of the lungs; it is often possible to determine whether the oil has reached the part by the production of bubbling râles. Under this treatment the majority of cases improve, appetite returns, weight is increased, and expectoration is diminished; but it is those in the first or second stage of tuberculosis who are most benefited. Dor (Rev. de Méd., Feb., '90).

In the treatment of phthisis creasote may be said to have superseded all other remedies. When used in the earlier stages of the disease, along with other measures, out-of-door life, proper food, etc., it is undoubtedly able to afford cures.

Of 93 phthisical patients treated by creasote 54 were benefited and 25 apparently cured. Bouchard (Archiv. Clin. de Bordeaux, Mar., '89).

By the hypodermic use of a 10-per-cent. solution of creasote in oil of sweet almonds, making the injection into the cellular tissue of the external iliac fossa, the medicament can be introduced into the circulation without any derangement of digestion. At least two injections, each of 75 minims of the solution, should be given daily. Perron (Gaz. Heb. des Scien. Méd., May 25, '90).

Subcutaneous injections of creasoted oil gives excellent results in the treatment of all wasting diseases, pulmonary or otherwise. The injections are followed by local and general effects, but never of serious nature; absorption is more or less rapid, and no abscess produced. The best results are had in apyretic phthisis, with or without abundant expectoration. Guerder (Jour. de Méd., May 3, '91).

Creasote diminishes expectoration, lessening its purulency and the tendency to hæmorrhage. Burney Yeo ("Man. Prac. Treat.," vol. ii, '92).

In a series of one hundred cases it was noted that its chief action was to lessen cough and expectoration, without influencing the progress of the disease. Osler ("Prac. of Med.," '92).

It certainly exerts a curative influence on the tubercular lesion and, besides lessening expectoration, purulency, and the tendency to night-sweats, it seems to diminish the number of tubercular bacilli. Jaccoud (Bull. Gén. de Thér., '92).

Creasote used in nearly four hundred cases, including not only the pulmonary form, but tubercular disease of the peritoneum, the joints, the bones, the glands, and the larynx. Great care is demanded, both as to the method of administration and the quality of the drug. A convenient way of prescribing it is in capsules containing 2 or 4 minims of creasote mixed with codliver-oil; and these should always be given immediately after eating and never on an empty stomach. After several days complete tolerance is established, and within four or five days the dose can be gradually increased, until finally the stomach improves in every way, and all irritation with the accompanying indigestion has been relieved. In regard to the method of increasing the dose, the following rule will be found to work well: Begin with 2-minim doses three times a day; in acute cases increase the dose by 2 minims every fourth day until 12 minims are given at one time; then observe the results of the largest dose for several weeks, and, if the improvement is not satisfactory, carefully add 2 minims more every eight or nine days until a 20-minim dose has been reached; then persist with this quantity until the symptoms warrant a diminution of the amount. The highest dose has frequently been used for four or five months at a time before decreasing it, with the most satisfactory results. The chronic cases do not, as a rule, require so large a dose, or to have it so rapidly increased. In average chronic cases the patients use 12 minims three times a

day, beginning with 2 minims, increasing by 2 minims every six days to 8 minims, then every second week to 12 minims, according to the effect. During the first week or ten days there are troublesome eructations of gas flavored with creasote, but not a single instance has been seen where this did not entirely subside after the creasote had corrected the fermentation caused by old indigestion. Conway (*N. Y. Med. Jour.*, June 1, '95).

Before giving the patient with phthisis creasote he should be placed in the conditions favorable to his recovery by submitting him to the air-cure. For really successful treatment large doses of creasote are required; the greater the quantity of the medicament which the patient can sustain, the more chance there is for recovery. It may be given in the mouth, the rectum, the trachea (by means of injection), and the skin. The most convenient forms in which to administer creasote by the mouth are pills and solution in codliver-oil, and in either of these the dose may be as much as 30 grains or even more per day. In many cases, however, doses of not more than 3 grains cause indigestion, and a tuberculous patient should, above all else, be kept free from disturbance of his digestive functions. The rectum is less able to tolerate the remedy than the stomach, and after a very few days the patient loses control of the bowel and is frequently attacked by colic and diarrhoea. E. Chaumier (*Lancet*, Jan. 22, '98).

When tuberculosis of the larynx complicates the pulmonary trouble, creasote should be employed locally as well. The fact should be borne in mind, however, that the benefit observed will mainly depend upon the internal administration of the remedy, though the local applications greatly assist the curative process.

Creasote is quite as efficient in laryngeal tuberculosis as it is in the pulmonary form, but should be used both internally and topically. For the latter an oily solution is preferred, such as

R Beech-wood creasote, 2 drachms.

Oil of wintergreen, 2 drachms.

Hydrocarbon oil, 1 drachm.

Castor-oil, 3 drachms.

The oil of wintergreen and castor-oil should first be mixed together, then the hydrocarbon oil added, and, lastly, the creasote. Sterilizing the solution by dry heat gives it a much clearer appearance; besides it is very fluid and non-irritating, of pleasant odor and taste. It may be used as a spray, or applied with a laryngeal applicator or as a submucous injection. Topical application alone may be relied on for the successful relief of the symptoms of primary tubercular deposits with infiltration and hypertrophy of the mucous membrane, provided the temperature is not high and the general condition is good. If, on the other hand, the evening temperature is high and the case seemingly progressing to active ulceration, a few submucous injections should be used as adjuncts to local treatment. The cough, laryngeal soreness, and moderate dysphagia of primary cases are quickly relieved by sprays of creasote, but resolution of their infiltrations and hypertrophies is not so rapid. In several patients laryngeal distress was relieved after a few applications, but the infiltration continued for months.

The interior of the larynx should be thoroughly cleansed before any treatment is undertaken. Applications may be made by means of down sprays, of the laryngeal syringe, or by absorbent cotton on an applicator; but the latter occasionally produces an undesirable amount of coughing. An 8- or 10-percent. solution of cocaine should first be carefully applied to the larynx, and, after it has had time to produce moderate anæsthesia, the spray of creasote (2 drachms to the ounce) is used. After the spray the pyriform sinuses may be filled with creasote solution, and also some of it allowed to drop into the trachea through the opening of a gum-elastic tip drawn over the cannula of the syringe. This keeps the laryngeal surfaces bathed in creasote for a considerable period, and the patient should, if possible, be kept perfectly quiet and not allowed to talk or swallow for half an hour after-

ward. The stronger solution of creasote may be used every third or fourth day and the weaker ones every day or so, depending entirely on the amount of stimulation it produces; the laryngeal membrane becomes very red and considerably swelled from too-frequent applications. In the ulcerative stages of laryngeal tuberculosis sprays of a drachm of creasote to the ounce may be used daily with advantage; but if there is no ulcerative process a personal experience of each must decide the frequency of the applications. A slight burning sensation follows, but it only lasts a few minutes; and the disagreeable taste is very effectually covered by the wintergreen-oil. Where there is ulcerations, both topical applications and submucous injections are advisable, as they hasten the separation of sloughing tissue, stimulate healthy granulation, and at the same time arrest progress. The injection should be as superficial as possible, as the primary tubercular deposit is immediately beneath the epithelial layer. Weak solutions of cocaine may be sufficient in some cases, but complete anæsthesia is usually necessary, and 20-per-cent. solutions are generally the most satisfactory, administered on an applicator,—although it may be safe to employ the spray if the physician is well acquainted with his patient. Little pain or reaction follows the injection of oily solutions, but pure creasote causes a burning sensation and considerable soreness, which lasts a variable time. Much depends on the locality of the injection; the posterior surface of the arytenoids seems to be specially sensitive. There is little or no hæmorrhage after the needle is removed, and on the following day the mucous membrane is more tense and possibly somewhat redder. This condition subsides in the course of a few days, leaving the tissues in a wrinkled condition, as if the mucous membrane were too large for the subjacent parts. This is most noticeable around the arytenoids. Careful judgment is required to determine how often the injections should be given, but, as a rule, it should be once in five or six days. If ulceration is proceeding rapidly, one injection may be given daily until

three or four have been administered. After several injections it is well to wait for a time and see if the circle of resolution will not spread from the point of injection to the neighboring tissues.

The ventricular bands usually require superficial and deep injections, the former to reach the deposits in the bands, and the latter the ventricles of the larynx. The interarytenoid space should be treated from below upward, otherwise it would be impossible to obtain a good view after the first injection. Very superficial puncture should be made in the mucous membrane covering the arytenoids, as it is an easy matter to start a perichondritis in this situation. A row of injections should first be made around the base of the arytenoid cartilages and gradually approach their tips. Tubercular infiltration of the epiglottis renders it so thick and firm that it is capable of bearing considerable pressure and is readily subjected to this treatment. A single row of injections may be made around the free border of the epiglottis about half an inch apart. The lingual surface of the epiglottis is very accessible for injection, but the laryngeal surface is not so easily reached. If the anæsthesia is complete the epiglottis may, in some cases, be pulled forward sufficiently by the shank of the needle for the injections to be made. If this cannot be effected, the needle may be pushed through the cartilage from its lingual surface. After the injections the larynx should be kept as clean as possible, and sprayed every day or so with the weaker solution of creasote. Chappell (*N. Y. Med. Jour.*, Mar. 30, '95).

Creasote in lung affection is somewhat discounted by the irritant effects of large doses, leading to chronic inflammation of the alimentary tract. Creasotal (creasote carbonate) was introduced to overcome this advantage, and it breaks up in the intestine into creasote and carbonic acid. The decomposition is a slow one; so that the organism is more or less continuously under the influence of creasote, which is excreted by the lungs and kidneys. It may be given alone in teaspoonfuls, or, if the patient is very susceptible to its slight taste, this may be covered

by milk, sweet wine, etc. Very large doses (even 300 grains per day) can be administered without upsetting the digestion. Just at first there may be some nausea or even vomiting, but these do not contra-indicate the continued use of the drug, as they soon pass off. Creasote carbonate has precisely the same specific action upon pulmonary tuberculosis as creasote; in addition it is of exceptional value in the symptomatic treatment, diminishing and deodorizing the expectoration and improving the appetite, which may even become ravenous by its use. It has a favorable influence on the general condition, improving nutrition and leading to increase of body-weight, and so indirectly limiting the spread of the lung affection. It is to be preferred to creasote because of its milder action, and is indicated in cases where the latter is tolerated with difficulty or not at all. Reiner (*Inter. klin. Rund.*, Sept. 15, '95; *Brit. Med. Jour.*, Jan. 25, '96).

Creasote valerianate may be given in capsules, 3 minims thrice daily, and slowly increased until from 25 to 30 minims can be taken during the twenty-four hours. Its use with thirty-five patients evidences it as an excellent substitute for pure creasote. Grawitz (*Ther. Monats.*, vol. vii, '96).

Creasote possesses undoubted power to relieve the factor of foul expectoration in bronchiectasis and phthisis. It modifies in a very appreciable manner the ordinary course of the latter disease. Shradly (*Med. Rec.*, June, '96).

Creasote is one of the most efficient remedies in pulmonary tuberculosis. Probably no one drug exerts so favorable an action on the night-sweats, cough, and expectoration. It is of less value in cases accompanied by high temperature and hæmoptysis, and often aggravates these symptoms. It must be remembered that many of the cases alleged to have been cured by creasote have been treated with codliver-oil, tonics, and hygienic method, as well. In any event, large doses are necessary, and tolerance can usually be established by gradually increasing. Capsules are the least offensive mode of administration, though some persons prefer to take the drug in milk.

Butler (*"Text-book of Mat. Med., Therap., and Pharm."*, '96).

Creasote in full doses is strongly recommended in phthisis, especially in non-febrile or only slightly-feverish cases. It is said to diminish expectoration, improve appetite, and increase weight. A good formula is

R. Creasote, 2 minims.

Com. tincture gentian, 15 minims.

Rectified spirit, 20 minims.

Water, to make 1 ounce.

M. For one or two doses.

The creasote in this mixture may be increased up to 10 or even 12 minims without increasing the other ingredients. Ringer and Sainsbury (*"Hand-book of Therap."*, '97).

One hundred and three cases of pulmonary tuberculosis studied. The dosage of creasote began with 5 minims three times daily, gradually increased to 25; also generous diet insisted upon, along with weighing at regular intervals. In not a single instance was appetite unfavorably influenced. Cough and expectoration steadily improved, and in most the physical signs were either the same or indicated less involvement of the lung. It is apparent that the remedy favorably influences the fever and night-sweats, and that it is superior to others in that it does not interfere with, but rather favors, the nutrition of the patient. Jacob and Nordt (*Berliner Charite-Annalen*, S. 159, '97).

In the treatment of phthisis the drug is well borne. Of 23 cases, 6 were in the pretubercular state,—catarrh of the apices,—and 17 had already developed tuberculosis, and all were markedly benefited. Woodbury (*N. Y. Med. Jour.*, Sept. 4, '97).

WHOOPING-COUGH.—Both creasote and carbolic acid, by inhalation, often prove of great value in this malady, but it should not be persisted in if they induce giddiness or a sensation of intoxication.

Creasote seems especially useful when the cough is violent and protracted, and out of all proportion to the amount of expectoration, when, indeed, the cough seems largely to depend on an excitable

state of the nerves. Its effect is often rapid and complete; in fact, there are few remedies that afford, in some cases, so much and so rapid relief. Ringer and Sainsbury ("Hand-book of Therap.," '97).

Brilliant results are had from the use of creasote, not only in phthisis, but in the sequels of whooping-cough, and the catarrh which often follows measles: two conditions which afford favorable opportunity for tuberculous infection. The usual treatment by means of expectorants is too often without results. Hock (Tex. Med. Prac., Nov., '97).

BRONCHITIS AND BRONCHIECTASIS.—Bronchitis is another malady in which the drug sometimes appears very useful. In bronchiectasis it has been strongly recommended by Chaplin. (See **BRONCHIECTASIS**.)

The inhalation of steam impregnated with creasote, 10 to 20 minims to a pint of hot water (140° F.), is valuable in some cases, lessening overabundant expectoration. It will generally, also, remove the factor of the breath occasionally met with, and sometimes even that due to gangrenous lung. Ringer and Sainsbury ("Hand-book of Therap.," '97).

PNEUMONIA.—Because of its expectorant and stimulating qualities, recently the drug has been advantageously used as a remedy in this disorder.

In 26 cases of pneumonia, forming part of a somewhat serious epidemic, it was given on the third day. All recovered. Some treated with creasote in tincture of gentian alone; in others this was supplemented by digitalis or caffeine in small doses. The cases treated with creasote recovered more rapidly and more thoroughly than those treated in other ways. No unpleasant effects supervened from its use. Casati (Brit. Med. Jour., vol. i, '97).

CRETINISM. See **INFANTILE MYX-CEDEMA**.

CROUP.

Definition and Varieties.—Confusion still exists in the classification and no-

menclature of diseases of the larynx in children. This is due largely to the fact that those diseases are not well defined, but merge into each other. In young children two elements are to be detected in laryngeal affections: catarrh and spasm. Two forms of croup have, therefore, been described: the catarrhal and the spasmodic. Such a classification seems, however, unnecessary and confusing. Catarrh and spasm are present in all cases, one being predominant in one instance, the other in another. A slight degree of catarrhal inflammation is invariably present. The form of spasmodic croup marked only by spasm with no evidence whatever of catarrh, as described by some authors, is extremely rare, if it ever occurs. There is invariably present a more or less decided catarrhal element; tracheitis and bronchitis are prone to follow. In most cases, at the outset, the laryngeal spasm overshadows the catarrhal element; later, the catarrhal becomes more prominent. The disease may be mild or very severe. Many authors, therefore, describe two forms—a mild and a severe type; but these forms differ in degree rather than in kind.

Catarrhal Croup.

Symptoms.—In rare instances the onset of catarrhal croup is sudden, with no premonitory symptoms. More commonly the child has a slight cough and coryza and becomes hoarse during the afternoon and perhaps feverish in the evening. Late in the evening the cough becomes loud, dry, and hoarse, its characteristics being peculiar and distinctive. In the great majority of cases this occurs between the hours of nine and twelve. The child wakes suddenly with the characteristic cough and begins to struggle for breath. He frequently becomes alarmed at his inability to breathe, and his fright adds to the severity of the symptoms.

In attacks of ordinary severity the respiration is loud and noisy; the voice is hoarse, but rarely lost; the dyspnoea is sometimes extreme and the respiration so noisy that it can be heard in an adjoining room. The loud metallic cough is very different from the stridulous, suppressed cough of a well-developed case of pseudomembranous laryngitis. There is frequently extreme recession of the various thoracic spaces. The temperature is usually somewhat elevated, but rarely reaches 102° . The lips and nails frequently assume a purplish hue, but are rarely cyanotic. There is often a discharge from the nose, and the eyes are sometimes congested and watery; conditions not usually present in pseudomembranous croup. After two or three hours the symptoms usually subside. Occasionally they appear in less severe form later in the night, but, as a rule, all urgency is passed by early morning. In some instances the child is almost as well as usual during the following forenoon and shows but little evidence of the experiences of the night. The attack, however, is usually repeated during the following night, and may recur for several nights, becoming less severe with each succeeding attack. In my experience, however, this freedom from symptoms on the following day is extremely rare. More commonly the child continues to be feverish and has a troublesome cough, although it may not be croupy in character. In the damp climate of New York and vicinity an attack of croup, as a rule, is but the initial symptom of a bronchial or laryngeal catarrh, which requires several days or a week or more to run its course. Attacks more mild in form, but similar in nature, are of frequent occurrence and must be considered as simply mild attacks of croup. In other instances the attack appears to be really

one of bronchitis, with a dry and croupy cough at night.

Differential Diagnosis.—In typical cases of catarrhal croup the diagnosis is evident at a glance. The sudden onset during the early hours of the night; the immediate development of extreme symptoms; the loud metallic cough; the noisy respiration; and the terror of the child, all combine to form a very characteristic clinical picture. In less typical cases, however, the diagnosis is sometimes difficult.

Catarrhal croup should be distinguished from acute catarrhal laryngitis. The latter disease may be primary, secondary to the infectious diseases, or traumatic. The lesions are found chiefly in the mucosa and lymphoid tissue of the subglottic region, and in severe cases they may be so pronounced as to cause laryngeal stenosis. This disease is frequently a complication of bronchitis. It is marked by hoarseness and a frequent, harassing, metallic cough, which always becomes worse at night and is usually aggravated by lying down. The milder and more common cases are usually seen in children between one and six years. Although extremely annoying, they are rarely dangerous or fatal. A severe type is sometimes seen, however, which may prove fatal. In this type the temperature is high; the voice is metallic and may be suppressed; laryngeal stenosis may become so great as to demand intubation. This disease is differentiated from pseudomembranous laryngitis with the greatest difficulty.

The disease may be mistaken for pseudomembranous croup, laryngismus stridulus, and even pneumonia. The presence of foreign bodies in the larynx must be excluded, as well as retropharyngeal abscess. The sudden onset, remission of symptoms, hoarseness without loss of

voice, loud metallic cough, with little or no stridor, and the response to treatment usually suffice to distinguish catarrhal croup from pseudomembranous croup, with its insidious onset; slower, but more steady and unremitting, course; suppressed voice and cough, increasing cyanosis, embarrassed expiration, and characteristic stridor. Laryngitis stridulus is a disease of early infancy. The symptoms occur in paroxysms, which are usually repeated many times a day and occur at no definite hour. They are unaccompanied by any evidences of catarrh. The disease invariably occurs in rachitic infants, and is a frequent accompaniment of tetany or general convulsions.

Croup is increased by alternations of dry and moist air. It is not always possible to obtain a view of the glottis in cases of suspected croup; therefore we have often to rely on the presence or absence of croupous exudate on the epiglottis, or on the tips of the arytenoids, for assistance in making a diagnosis. In one class of cases the cause of the stenosis lies only in the immobility and median situation of the vocal cords and the arytenoid cartilages, which are held together by false membrane in the interarytenoid space. In another class the stenosis is influenced by swelling of the mucous membrane under the glottis. Occasionally it is caused by the swelling under the glottis alone, the cartilages being normally movable; and in such cases the interarytenoid space is free from croupous exudate. Brühl and Fahr ("Diphtheria and Croup in Prussia from 1875 to 1882").

The onset of non-bacillary croup is much more sudden than that of diphtheria, and the temperature rises more quickly and to a higher point. The membrane has not the dead-white appearance of diphtheritic membrane. It is yellowish in color, softer, less firmly matted together, and more easily detached from the underlying tissues. Placed in water, the membrane swells up, losing its characteristic shape. The surface from which

the membrane has been detached is seldom bleeding or ulcerated, and may preserve its epithelium quite intact. Examined microscopically, the membrane is found to consist of pus-cells, leucocytes, and fibrin. J. O. Symes (Bristol Medico-Chir. Jour., Mar., 1900).

I have twice been called in consultation to find broncho-pneumonia in young children in which, when dry, difficult cough combined with an unusual degree of expiratory dyspnoea had been mistaken for croup.

Etiology.—Age is an important predisposing cause of the disease, which is most common between two and five years. It is very rare under one year and over eight. It may occur, however, at any time until adolescence, and I have seen a typical case in an adult.

Case of croup, with fatal termination, observed in a lady of 60 years, who had had several attacks of spasmodic croup at about 40 years of age. Waxham (No. Amer. Pract., Sept., '91).

Heredity is also an important predisposing cause, the disease occurring with especial frequency in some families. Enlarged tonsils and adenoid growths also predispose to croup. It is sometimes brought on, apparently, by atmospheric conditions, as it is not uncommon to see several cases at about the same time. It cannot, however, be called an epidemic disease. Exposure to cold is undoubtedly the most important and exciting cause. Excessive use of the voice in damp and cold weather is, also, a frequent cause. Indigestion will often, undoubtedly precipitate an attack in a sensitive child.

Pathology.—The lesions of catarrhal croup are found chiefly above the vocal cords and are those common to all catarrhal inflammations of the mucous surfaces. The spasmodic symptoms are due chiefly to spasm of the adductors. The disease may appear primarily in the

larynx or it may extend from the nasopharynx downward or more rarely from the trachea upward.

Prognosis. — Ordinary types of catarrhal croup are never fatal. In very rare instances in which the catarrhal element predominates and is very severe, the prognosis may be grave. In other words, catarrhal croup is rarely or never fatal, while severe catarrhal laryngitis with spasm may be a dangerous disease.

Treatment. — Preventive treatment consists in the removal of all evident exciting causes, such as enlarged tonsils and adenoid growths, and in the relief of indigestion. Exercise in the open air is important, but the child must be properly clad, and all exposure should be avoided. Screaming and excessive use of the voice while at play during damp and stormy weather should be prohibited. Anæmic and delicate children should receive proper constitutional treatment. Relief of the paroxysms may be sought by external application and medical treatment. A large, hot poultice over the throat and chest will do much to relax the spasm. A large bath-sponge saturated with water as hot as the child can bear and applied to the throat is almost as effective as a poultice and is more readily managed. Vigorous rubbing with hot, camphorated oil is also efficacious. The use of the croup-kettle and tent will sometimes prove more effectual in stubborn cases than any other measure. The steam seems to be the effective agent, but is somewhat aided by the addition of volatile substances, particularly creasote in small amount.

Among drugs, ipecac, opium, and antipyrine have proved most efficacious in my experience. If there is acute indigestion, emesis through the use of ipecac will sometimes check the attack permanently. In other cases emesis is not usu-

ally followed by complete and permanent relief. The wine of ipecac is more prompt and effective in its action than the syrup. Opium I have found the most efficacious drug in checking spasm. One full dose, adapted to the age of the child, may be given, but the ipecac may be repeated several times. It is not best to produce vomiting. During recent years I have used chiefly tablet triturates of brown mixture, the active principles of which are opium and antimony. Antipyrine is an extremely effective drug in most cases, but sometimes fails to give material relief. The best results are seen from its use when the catarrhal element is slight and the spasmodic element marked. It is a comparatively-safe drug for use among children. Two grains may be given at two years, half the dose to be repeated in one hour if necessary. My most common plan of treating the paroxysm is as follows: After evacuation of the stomach and bowels in case of indigestion or constipation, a hot sponge or poultice is applied to the throat and a full dose of antipyrine and brown mixture (*mistura glycyrrhizæ comp.*) is administered, the latter in the form of tablet triturate. If no relief is manifest in forty-five minutes, a second dose is given, while a few 10-drop doses of wine of ipecac are given in the interval.

Relief of the muscular spasm can be accomplished very effectually by spraying the mucous membrane of the throat with a 2-per-cent. solution of cocaine. A. O. Stimpson (*Med. and Surg. Reporter*, Mar. 27, '97).

Coal-oil, in doses of 15 to 30 drops on sugar, or syrup, every fifteen or thirty minutes, according to age and severity of the case, is of great value. It may also be used with turpentine and lard, on throat and chest. Caspar Q. West (*Med. Brief*, June, '97).

On the following day cough or bron-

chitis is treated by the use of brown mixture given in doses indicated by the symptoms and the age of the child. They may be increased in frequency as night approaches. Antipyrine is very effective in preventing recurrence on the following nights. Two grains administered in the afternoon and again in the evening will alone frequently prevent the attack. It can, however, be given in addition to the usual cough-mixture.

Creosotal used in croup, with pronounced success. In one case a complicating pneumonia was checked at its onset and a favorable change in the croup itself brought about over night. Two similar cases also improved rapidly, while some of those treated with serum died. In pseudocroup a dose sufficiently large to cause the characteristic odor about the breath and perspiration must be given; when the fever falls, smaller doses are employed for some time to prevent a recurrence. L. Lasansky (*Deutsche med. Weitsch.*, Nov. 13, 1902).

Membranous Croup.

The etiology and nature of pseudomembranous laryngitis was for years the subject of much discussion. The question has at last been settled by the bacteriologist, who has demonstrated that in the great majority of cases the disease is diphtheritic. It is equally demonstrated, also, that a certain proportion of cases are not diphtheritic.

Membranous croup and diphtheria are differentiated by the following points: The membrane of diphtheria is of a yellowish hue, the temperature of the body rather high, and the membrane is apt—in fact, certain—to curl up at the edges; while in membranous croup the membrane is white, does not curl at the edges, is devoid of all peculiar odor, and the temperature is rather low. Carl Seiler (*Jour. of Laryngology*, Aug., '90).

Of 286 cases, reported by Park and Beebe, the Klebs-Loeffler bacillus was present in 229. In the remaining 57

cases it was not present, but in 17 the examination was not satisfactory. The observations of recent years have shown that a pseudomembrane developing primarily in the larynx is almost invariably associated with the Klebs-Loeffler bacillus; that is, it is true diphtheria. Pseudomembranous inflammation of the larynx secondary to diphtheritic inflammation of the pharynx is invariably true diphtheria. A pseudomembrane developing in the larynx secondarily to the pseudomembranes which develop during the course of the infectious diseases is commonly pseudodiphtheria. Such pseudomembranes are associated with microorganisms other than the Klebs-Loeffler bacillus, generally the streptococcus.

Case of pneumococcic croup in a child of 8 years, who, during an attack of influenza, manifested an erythematous angina. Laryngeal stenosis rapidly supervened and, despite the injection of Roux's antitoxin, called for tracheotomy on the evening of the same day. The wound gave issue to a false membrane of colloid appearance, which gave a pure culture of the pneumococcus. The case recovered. *Seuvre (Revue Men. des Mal. de l'Enfance*, Mar., '98).

Whatever the cause of the disease, whether bacillus or streptococcus, it manifests itself simply as a pseudomembranous laryngitis, stenosis being the important symptom.

Symptoms.—As the disease is so frequently diphtheritic in nature, it will be considered in detail in the section on diphtheria. Owing to the slow absorption of toxins by the laryngeal mucous membrane and the comparatively short course of the disease when confined to the larynx, the constitutional symptoms of diphtheria are slight. Hence, croup pursues practically the same course whether due to diphtheria or pseudodiphtheria. It is impossible from clinical evidence alone to determine whether

the disease is true or false diphtheria. As it is true diphtheria in a very large proportion of cases, the only safe rule in practice is to consider every case of croup to be diphtheritic and to use precautions accordingly.

Pathology.—In some cases the anterior portion of the larynx alone is involved by pseudomembrane. In other cases the whole mucous membrane of the larynx is covered. In many instances the membrane does not pass below the larynx. In both true and pseudodiphtheria the membrane is but one element in the production of stenosis, cedema and swelling of the tissue underneath the pseudomembrane being an important contributing cause.

Prognosis.—Unlike pseudodiphtheria of the pharynx, pseudodiphtheria of the larynx is almost equally fatal with true diphtheria, as it causes death by mechanically obstructing respiration. Until a few years ago the age of the infant was the most important factor in prognosis, the younger the child, the more fatal being the disease.

The younger the patient, the higher the mortality, because of the small size of the trachea and larynx and because stenosis sooner results; the prognosis is unfavorable in the mildest cases; unfavorable symptoms are increasing debility and cyanosis, feeble and irregular pulse, and the development of bronchitis or broncho-pneumonia. Dodge (Med. and Surg. Rep., Mar. 21, '91).

Age is still a very important factor, but prompt treatment with antitoxin must be considered of far greater importance in modifying the prognosis.

Treatment.—The efficacy of the antitoxin treatment of diphtheria has been too fully established to permit of doubt or argument. It is more effective in croup than in any other form of diphtheria. An injection should be given on

a clinical diagnosis without waiting for a bacteriological examination. Its early use will, in a large proportion of cases, prevent the necessity of operation. Next to the antitoxin treatment, calomel fumigations have, in my experience, proved most efficacious.

[Vaporization of calomel: A powder consisting of from 15 to 30 grains (1 to 2 grammes) of calomel is placed upon a tin plate, and heat applied until all of the powder has been vaporized; this should be done under a tent erected over the patient's bed, the curtains of which should be kept closed for ten minutes to a half-hour after each fumigation. Dense, white fumes are evolved, which are not, however, irritating to the patient, and the change in the respiratory sound, after the first burning of the calomel, is sometimes very marked. There have been no cases of salivation reported as yet in patients, but nurses and people who have to be in the room during sublimation of the calomel have, in several instances, been salivated; so due care must be exercised. J. LEWIS SMITH and FREDERIC M. WARNER, Assoc. Eds., Annual, '93.]

Calomel fumigation in the treatment of croup is the most valuable means of medication in this disease possessed at present (1893), and will save a larger percentage of cases without the aid of surgery than any other method of treatment. It is also capable of doing much harm. From 10 to 20 grains may be used, according to the size of the tent in which the patient is placed, every two hours during the first day, increasing the interval to three hours on the second day, and so on, according to the progress of the disease. The patient should be left in the tent for fifteen minutes at each sitting and the flame of the spirit-lamp so regulated that the calomel all evaporates within this time. Nurses or attendants who remain much in the same room soon become ptyalized and older children occasionally show constitutional effects. In order to obtain the best results, the fumigation should be resorted to early, or before the mu-

cous membrane becomes lined with a layer of pseudomembrane. George McNaughton and William Maddern (*Brooklyn Med. Jour.*, Aug., '93).

Case of a child with true croup in which intense dyspnea was present; before resorting to tracheotomy, inhalations of vaporized calomel, 30 grains, were resorted to, with entire success; in ten minutes the patient was quiet and comfortable and without dyspnea. The next day the same symptoms reappeared, and like treatment was resorted to with equal success; on the fourth day the child was convalescent. Rothn (*Der Kinder-Arzt.*, Mar., '90).

Intubation should be performed promptly when indicated.

The following are indications for the performance of intubation: Given a case of membranous laryngitis, with hoarseness increasing to whispering, with cough short and explosive, becoming high-pitched and prolonged, diminution of or absence of the vesicular breathing, over the lower posterior lobes of the lungs, beginning recession of the epigastrium and beginning restlessness, the call is for immediate removal of the obstruction. Note especially the character of the voice and cough; if these become progressively worse, the child's best interests will be served by delaying no longer the necessary intubation. Ground (*North-western Lancet*, Sept. 1, '91).

[There are only two impediments to the introduction of a tube of proper size in any form of acute stenosis of the larynx, viz.: entering one of the ventricles or a subglottic stenosis. Neither spasm of the glottis, nor pseudomembrane, nor oedema, when situated in or above the chink, ever offers any serious objection to the passage of a tube. J. O'DWYER, Assoc. Ed., *Annual*, '92.]

Result of a collective investigation on intubation in Germany including 1445 cases intubated for the relief of croup: there were 553 recoveries, or 38 per cent. One hundred and twenty-one of the cases were secondary to measles, scarlet fever, pneumonia, etc. Secondary tracheotomy was resorted to in 250 of the cases, with only 20 recoveries, or about

7 per cent. This number proves for itself that the dangers which were formerly charged against this operation must have been greatly exaggerated. Ranke (*Münchener med. Woch.*, No. 44, '93).

Individual experience in 500 cases treated by intubation: there was not a single death from pushing down membrane before the tube. When this accident, which was uncommon, did occur, the obstructing membrane was usually expelled after the withdrawal of the tube. The string is always left attached, and, if passed through a piece of fine rubber tubing, which stands a good deal of chewing, it will avoid being cut by the teeth. Bökei (*Jahrbuch für Kinderh. und physische Erziehung*, June 5, '94).

The results obtained by the use of anti-toxin, followed, when necessary, by intubation, have robbed one of the most deadly diseases of many of its terrors. (See DIPHTHERIA.)

Tracheotomy for croup from December, 1886, to February, 1892, 115 times; recoveries, 39.93 per cent.; 5 cases died during the operation. Bajardi (*Archivio Ital. di Ped.*, July, '92).

Five hundred and seventy-two tracheotomies performed in six years for croup; of these cases, 316, or 55 $\frac{1}{4}$ per cent., died. Hagedorn (*Deut. Zeit. f. Chir.*, B. 33, H. 6, '93).

Among the other measures recommended, turpentine and hydrochlorate of ammonia hold a prominent place, but the measures already outlined are to be preferred.

Turpentine in membranous croup is of extreme value. The drug should be administered in drachm-doses, repeated every hour for from four to six doses, then suspended for six or eight hours. The membrane becomes of a muddy-yellow color, and is thrown off. If this change does not take place, recourse should be had again to the turpentine for three or four doses. S. L. McCurdy (*Columbus Med. Jour.*, Apr., '90).

Turpentine internally in large doses recommended. In 13 cases of croup treated with drachm-doses of turpentine,

there were 8 recoveries. In only one case was any disagreeable effect of the remedy observed, and that was a strangury of temporary character, after 15 drachms had been given in twenty-four hours, to a boy 4 years of age. Kellogg (Med. and Surg. Reporter, July 9, '92).

Hydrochlorate of ammonia is valuable (1) as a heart-stimulant, (2) in relieving the spasm and œdema of the glottis, and (3) in softening the membrane. Hubbard (Med. Rec., Apr. 11, '91).

The following formula, suggested by Joseph Holt, of New Orleans, has been tried many times with the happiest results:—

R Chloralis, 7 grains.

Potassii bromidi, 45 grains.

Ammonii bromidi, 30 grains.

Aquæ cinnamomi, 2 ounces.

M. Sig.: Teaspoonful, and repeat in twenty minutes if not relieved.

This is intended for a child about 5 years old. For younger children the dose is slightly diminished. This prescription is of no benefit in true, or membranous, croup, when diphtheria antitoxin must be promptly used. H. R. Slack (Jour. Amer. Med. Assoc., May 6, '99).

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CROUPOUS PNEUMONIA. See PNEUMONIA.

CUBEB.—*Cubeba officinalis* is a climbing perennial found generally throughout the East Indies, and abundant in Java, Batavia, Saranak, New Guinea, Nepane, and the Isle of France. The fruit is the part employed medicinally, and appears as partly shriveled or wrinkled berries, owing to the fact they are gathered prior to ripening, bearing considerable resemblance in point of size, and also in color, to black pepper and piments, but less globose and furnished with a stout stalk that is continuous with raised veins that run over the surface of the fruit and embrace it like net-work.

The shell is hard, and contains a single loose seed covered with a blackish coat, but internally white and oleaginous with pungent aromatic taste and a peculiar aromatic odor that, once experienced, will never be forgotten. When reduced to powder the general tint is chocolate-brown, becoming darker with age, and an oily look and feeling. A good quality freshly ground yields about 14 per cent. of volatile oil, which, however, is readily dissipated with age; little powdered cubeb as found in shops will yield more than 4 per cent. of oil, and much of it is worthless.

Oil of cubeb is a greenish-yellow fluid possessed of a warm, camphoraceous taste and aromatic cubeb odor, soluble in alcohol, ether, and chloroform; it yields cubebic acid; cubeb-camphor, or stereopten; and cubebin.

Cubebic acid is a white, wax-like mass that, by exposure, acquires a brown hue and resin-like consistency; soluble in alcohol, ether, chloroform, and alkaline solutions.

Oleoresin cubeb is identical with the preparation formerly known as ethereal extract.

Cubeb-resin is an amorphous body soluble in alcohol and alkalies. Cubebin, at one time supposed to be identical with piperine, is a precipitate most easily obtained from the oleo-resin (ethereal extract); it is white, crystalline, inodorous, and highly bitter, especially if dissolved in alcohol. Like cubeb-camphor, it is therapeutically inert.

Preparations and Doses.—Cubeb extract, ethereal (oleoresin), 5 to 30 minims.

Cubeb extract, fluid, 10 to 60 minims.

Cubeb extract, solid, 2 to 8 grains.

Cubeb infusion (4 to 16), 1 to 2 ounces.

Cubeb-oil, 10 to 30 minims.

Cubeb, powdered, 10 to 60 grains.

Cubeb tincture, 15 to 120 minims.

Cubeb troches, 1 to 5; each should contain 3 grains of powdered cubebs with fruit-paste.

Cubebic acid, 5 to 10 grains.

Physiological Action and Therapeutics.—Cubeb is stimulant, aromatic, stomachic, diuretic, expectorant, antiseptic, and mild diaphoretic; cubebic acid is markedly antiblennorrhagic. Appetite and digestion are generally increased and improved by cubeb preparations; but too large doses or too prolonged use are apt to induce gastro-intestinal irritation, and, while exerting a laxative action, occasions a sensation of heat and discomfort in the rectum; there appears to be also a selective action for mucous membrane, more particularly that of the bladder and urethra. In very large doses (150 to 500 grains of powder) considerable febrile action is observed, along with griping, drastic purging, headache, nettle-like eruption, and, rarely, paralysis.

Cubeb, like other peppers, readily enters into the circulation and increases the force and frequency of the heart's action. It is absorbed and eliminated with considerable rapidity, chiefly by the kidneys, but also through the skin and bronchial mucous membrane.

CATARRHAL DISORDERS.—In maladies of a catarrhal character, such as gonorrhœa, gleet, leucorrhœa, vaginitis, infantile enuresis, chronic inflammation of bladder and prostate, chronic bronchitis and other pulmonary affections, it is of great value, and much of the ill repute that accrues to the drug is due to the dispensing of inert preparations and erroneous methods of application. As an example, the powder of cubeb is often recommended in such disorders as hay fever, chronic rhinitis, etc., in which local hyperæsthesia is an active factor. Such a use of the remedy serves only to discredit it.

Considerable benefit sometimes follows its use, however, when cubeb-leaves are smoked in cigarettes in disorders of the respiratory tract characterized by free secretion. A spray of lanolin more or less strongly charged with cubeb, according to the intensity of the trouble present, is also of marked value in catarrhal inflammations of the nasal and pharyngeal cavities. The troches of cubeb, 1 bean, slowly dissolved in the mouth every two hours, serve to maintain the beneficial action of the remedy.

CURARA.—This substance—known also as curare, woorari, ourari, urari, woorara, wourali, and ourali, though it has been before the medical profession for more than half a century—is practically unknown as to its source and composition. There is considerable evidence to show that it is derived in part from two or more trees of the strychnine group, from the *Menispermum cocculus* (*Cocculus Indicus*), and various unknown plants. It comes chiefly from the valley of the Orinoco,—Brazil, British and French Guiana, Venezuela, and Colombia,—where it serves certain savage tribes as an arrow-poison. It is by no means a stable or uniform substance; some appear to have mingled with it the poisonous principle of *Jatropha* (*Manihot utilissima*), known as *obi* or *obiah* poison in the West Indies, while that from Colombia is of lighter color, appearing as a yellowish-brown, amorphous, deliquescent powder. Brazilian and Guianian curare is a blackish, intensely bitter, hygroscopic mass of resinous appearance. Both are soluble in dilute alcohol to the amount of 70 per cent. and in the water to 75 or 85 per cent., but insoluble in ether. Two alkaloids have been segregated known as “curarine” and “curine.”

The Indians of the Orinoco prepare two kinds of curara: one a relatively-mild poison used in the chase, its chief source being *Strychnos gubleri*; the other much stronger, a war poison, from the *S. toxifera*. Planchon (Provincial Med. Jour., July, '88).

Preparations and Doses.—Curara, $\frac{1}{30}$ to $\frac{1}{2}$ grain.

Curarine, $\frac{1}{200}$ to $\frac{1}{50}$ grain.

Curarine sulphate, $\frac{1}{200}$ to $\frac{1}{100}$ grain.

Curine, uncertain.

Physiological Action.—Neither curara nor its alkaloids are ever employed except endermically (rarely) or hypodermically, since it is held that all are decomposed in the stomach and rendered practically inert. The latter is not true, however; but the process of absorption is extremely slow; but when employed subcutaneously it is rapidly absorbed. Elimination is rapid, chiefly by the kidneys, causing sugar to appear in the urine, and partly with the fæces; perspiration, saliva, nasal mucus, and tears, though greatly increased, do not seem to share in the eliminative process.

It is not absorbed by intact integuments, but is absorbed (though with difficulty) by mucous membrane. When introduced into the system and brought in contact with the systemic tissues, the drug develops identical biological effects in dogs, cats, rabbits, pigeons, amphibians, batrachians, reptiles, fishes, crustaceans, insects, and amœbæ. According to the duration of its contact with various organs and tissues, curara may paralyze either the central nervous system or terminations of motor nerves of any muscular structure (including the heart) and of the vagi; this least rapidly in dogs and rabbits. In mammals generally it causes death by paralyzing the respiratory centres, but not the peripheral respiratory nerves. The proximate cause of the biological effects of curara is, probably, constituted by the drug inducing some alterations in the protoplasm of both nervous and muscular structures, though to a different extent,

and not simultaneously. Dogiel and Nikolski (Medit. Oboz., No. 3, '90; Med. Chron., June, '90).

Curarine paralyzes the motor nerve-endings, but has no effect on sensory nerves. The irregularity and the early depression of the reflexes are not due to an action on the spinal cord or the sensory nerves, but to an inhibitory influence exercised upon the cord by a stimulation of the higher centres. The alkaloid likewise exerts a tetanic action on the cord, but the reason why it does not induce tetanic spasm, in the great majority of cases, when given hypodermically is because the circulatory changes produced are such as to prevent the drug from having access to the cord, and because these changes of themselves produce spinal paralysis. With larger doses there is dilatation of the abdominal vessels, and hence accumulation of blood, little or nothing of this fluid entering the empty ventricle, notwithstanding that the heart may continue to beat. Curarine causes an almost immediate fall of blood-pressure in mammals; it occurs even after section of vagi, after a paralyzing dose of atropine, after division of all the cardiac nerves, after section of the spinal cord, and after paralysis of the central reflexes by urethane. The cause, therefore, of the fall of pressure must be due to a direct action upon the peripheral nerves or upon the muscles of the blood-vessel walls. It was found, however, that when an injection of barium was made into the circulation a rise of pressure was produced, while, on the other hand, no such action was effected by stimulation of the peripheral nerves. Again, the vasomotor centre was found to be active by the appearance of the "Traube-Hering" curves during the cessation of respiration by the action of the drug. This evidently proves that curarine causes a fall of pressure solely by a paralyzing influence exercised on the vasomotor nerves. The inhibition of the vagi is destroyed by curarine easily in cats, less so in dogs, and with difficulty in rabbits. Small doses in a healthy rabbit caused the appearance of albumin, blood-pigment, and blood in urine.

An infusion of the bark of the *Strychnos toxifera* caused the same effects as curara and curarine.

Curine has no apparent effect on motor nerves, but acts on the heart like veratrine or drugs of the digitalis group. Tillie (Med. Chron., Mar., '91).

In poisoning by curara muscular power is notably diminished. Gréhan and Quinquaud (La Sem. Méd., Apr. 22, '91).

The action of the drug on muscle-tissue is a factor in the general paralysis induced. According to Reichert, doses insufficient to cause motor paralysis may increase the temperature, or primarily increase and secondarily diminish it. The use of quantities just sufficient to abolish voluntary motion act differently in different animals: the temperature from the first may be increased or decreased, or primarily increased and secondarily decreased, or primarily diminished and accordingly increased; generally there occurs a notable diminution or a decided increase, the former effect predominating.

A variety of curara from Colombia causes absolute paralysis of the muscle of the heart, the respiration continuing; and absolute paralysis and rigidity of the skeletal muscles at a much earlier period than happens in the case of an animal whose circulation has been artificially arrested; also exemption of the motor nerves from paralysis until after death and until the muscles show signs of poisoning. In an experiment upon a rabbit the effects produced were markedly different from those caused by ordinary curara. With the new drug the motor weakness only appeared near death; but there was marked action on the heart, as well as an early total paralysis of muscles and onset of rigidity. Tillie (Jour. Anatomy and Physiology, Oct., '93).

Medicinal doses render the pulse more full and exceedingly rapid,—there is marked dilatation of the blood-vessels of the skin and the various glands,—and the blood-pressure, though little affected

by small doses, is decidedly lowered by large ones. The action on the circulation is due to diminished inhibition on the heart, owing to paralysis of the ends of the vagi, while the accelerator nerves are stimulated. It elevates temperature.

Immoderate doses cause great muscular weakness and paralysis of all the voluntary muscles. The ends of the motor and sensory nerves are paralyzed, the former being soonest affected. Beyond a slightly-diminished contractility, the voluntary muscles are but little influenced. The spinal cord may be paralyzed by toxic doses, although the brain-centres remain unaffected until carbonic-acid narcosis sets in. It is likewise a powerful respiratory depressant, paralyzing the ends of the motor nerves distributed to the respiratory muscles; if the doses are lethal, the paralysis becomes central, finally producing death by its action on the respiratory muscles. Butler ("Text-book of Mat. Med., Ther., and Phar.," '96).

Poisoning by Curara.—In poisoning the movements of the heart are greatly accelerated, the pulse weak and dicrotic, the temperature high, respiration depressed; extreme muscular weakness ensues, with inco-ordination of movements; urine is saccharine; paralysis of extremities and respiratory muscles supervene, and death ensues from the latter cause.

Treatment of Curara Poisoning.—The treatment of the poisoning consists chiefly of artificial respiration and the employment of tetanizing agents, such as strychnine and picrotoxin. Alcoholic stimulants may be indicated. Caffeine, atropine, and chloral are sometimes of benefit.

Therapeutics.—Curara is more employed in the physiological laboratory than as a medicament pure and simple, and study of the drug on therapeutic lines has, in a measure, been inhibited because of its unreliable composition; so true is this latter that the caution is generally given that before any one sample

is employed in the human subject its strength should first be tested on one of the lower animals. Merck, however, puts out a reliable article: one that is carefully tested ere it is offered for therapeutic purposes. It is a powerful remedy for good when employed in convulsive diseases, such as hydrophobia, traumatic tetanus, and epilepsy, and sometimes yields good results in paralysis agitans, locomotor ataxia, nervous debility, and the dyspepsia of emphysema.

Case of a boy, aged 16 years, who had suffered with epilepsy since infancy and in whom the attacks occurred at intervals of a few minutes. After all other remedial measures had been exhausted $\frac{1}{10}$ grain of curara was injected hypodermically, when the attacks recurred at intervals of hours instead of minutes. After six injections of curara, at five-day intervals, in doses of $\frac{1}{10}$ or $\frac{1}{8}$ grain, complete relief was had; after several months no return of the epilepsy was experienced. Dobrorarow (La Sem. Méd., June, '94).

It would seem, from Tillie's researches, that a preparation from the bark of *Strychnos toxifera* would afford a remedy of the same scope as curara, and one, moreover, that would be uniform in strength. Used judiciously, it would probably be a valuable addition to the list of antispasmodics, one especially available in neuropathies.

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CYST. See SURGICAL DISEASES OF THE SKIN.

CYSTITIS.—Lat., from Gr., κύστις, the bladder, and ιτις, inflammation.

Definition.—Inflammation of the urinary bladder, involving one or more of its four coats: mucous, submucous, muscular, and serous.

Varieties.—Cystitis has been divided

into a large number of varieties, the subdivisions being based upon the many etiological and pathological features of the disease. A further classification of this disease into the acute, the subacute, and the chronic is dependent upon the intensity of the symptoms and the length of time of their existence and is utilized in this article.

Symptoms.—In acute cystitis the commencement differs somewhat according to the determining cause. When traumatic, it may be ushered in with rigors or marked chill succeeded by burning pain in the bladder and glans penis, etc. In other instances, and when from other causes, it is announced by a feeling of uneasiness, which is located in the perineum. There is increased frequency of urination and spasmodic pain during micturition and more or less fever. Usually the fever is absent, but, in the severe forms, there is moderate fever and sometimes, in the pseudomembranous variety, quite high fever. Usually the temperature in cases of fever range from 100° to 102° F., though it may be higher. These constitute the ordinary symptoms. Pressure upon the bladder is intolerable. The urine may be blood-tinged throughout the attack, but more usually is replaced soon by pus, and becomes ammoniacal. Acute retention is common. If complete retention ensues, the bladder gradually becomes more and more distended and can be felt as a rounded tumor, giving a dull sound on percussion, rising higher and higher above the pubes. The tenesmus vesicæ, or the feeling that the patient has not emptied the bladder after the viscus has been emptied, may occasionally be communicated to the rectum; and, in point of fact, all of the pelvic organs may participate in the painful and distressing sensation.

The frequent desire to pass water va-

ries in intensity. It may be every few moments or almost incessant; several times an hour or once in a couple of hours.

The constitutional disturbance, when the disease is of grave form, is very marked, as indicated by a frequent pulse, thirst, headache, and nausea, with great restlessness and mental anxiety. When cystitis progresses toward a fatal termination, portions of the walls of the bladder may suppurate or even slough, and may be discharged in stringy fragments; the urine emits a vile odor, from the products of its own decomposition and the gases resulting from the dead mucous and submucous tissue which it contains; the patient is harassed with hiccough; the pulse becomes very small and frequent, the tongue dry and hard, streaked with a dark coat; the strength rapidly fails; the secretion of the kidneys diminishes or is entirely suspended; the countenance becomes sunken and cadaverous, the extremities cold, the surface moistened with perspiration, from which emanates the odor of urine, and the patient at last passes into a state of profound stupor, from which he never awakens. (D. Hayes Agnew.)

In chronic cystitis the symptoms are mainly those of the acute variety, but in a milder degree. Only slight fever is present, but the combination of pain and other distress rapidly undermines the general health.

Case of cystitis without symptoms. The urine was pale, had a specific gravity of 1018, and contained much albumin and some leucocytes, with epithelial and granular casts. There was no uræmia. At the autopsy was found chronic cystitis, especially around the trigone. Martha Wollstein (Med. Rec., Jan. 23, '97).

The urine is turbid, alkaline, and contains much mucus and pus, which

forms a tenacious clot at the bottom of the retaining vessel. While the urine is usually alkaline, it occasionally is faintly acid, but, if so, promptly becomes alkaline, due to the formation of ammonium carbonate out of the normal urea, the probable result of the operation of bacteria.

There seems very little doubt that we have to recognize the existence of two distinct types of cystitis: one associated with acid and the other with alkaline urine. In the latter some of the organisms capable of decomposing urea and liberating ammonia are present, e.g., the *diplococcus ureæ liquefaciens*, the proteus Hauser, the *bacillus pyocyaneus*, etc., with or without the *bacillus coli communis*; in the acid forms of cystitis the latter organism is alone present. The former type has long been recognized and its characters noted; but practitioners are not so frequently on the lookout for cystitis with acid urine. Melchior (Centralb. f. d. Krankh. d. Harn- u. Sexual-organe, May, '97).

In a case of cystitis the symptoms—pain, pus in the urine, and frequency of urination—must be present, and they must emanate from the bladder. They may come from other causes, singly or combined. If singly, the disease is not cystitis; if combined, they may result from two or more diseases. In the beginning of acute cystitis there is often fever, depression, nausea, loss of appetite, constipation, etc. Hæmaturia is also often present. In chronic cystitis the urine is generally light in color, alkaline, of a lowered specific gravity, containing a slight amount of albumin, perhaps some blood, and pus in abundance. When allowed to settle, pus forms a more or less dense deposit on the bottom of the glass, above which there is a cloud of muco-pus. Bladder-epithelium is found, especially in the forms where ulceration is present. In all cases certain microbes of suppuration are present. Guitéras (N. Y. Med. Jour., Mar. 19, '98).

Cystitis papillomatosa occurs in the

female as a form of chronic cystitis, and may present the clinical picture either of the catarrhal or of the suppurative form. Its symptoms are frequency of urination, accompanied by more or less pain, and tenesmus, the urine passed being clear or turbid. Bleeding does not occur spontaneously, although it may follow instrumentation. Its seat is at the trigone, which it usually covers, and it may extend over into the urethra, from which at times it appears to start. Its villi, or papillæ, spring from an inflamed base, and are discrete. Frederic Bierhoff (*Med. News*, May 26, 1900).

The greater alkalinity thus resulting reacts upon the pus and converts it into a glairy matter similar to mucus, thus further increasing the difficulties of urination. (Tyson.)

Diagnosis.—This is usually easy. Yet there sometimes occur mild forms which it is difficult to differentiate from mild degrees of interstitial nephritis, while it not very rarely happens that these two conditions are associated. In contracted kidney there are sometimes many leucocytes also. The presence of hyaline casts, even when scanty, points to nephritis, while hypertrophy of the left ventricle and increased arterial tension settle the question. Still more emphatic is the diagnosis if there be retinitis albuminurica (Tyson). According to the same authority, the question whether there is pyelitis, separate or associated with cystitis, is still more difficult to determine. Catheterism of the ureter by the method of Howard A. Kelly, if a possible procedure in the given case, would, of course, clear up all doubt. Tyson places most reliance on the symptom of tenderness in the region of the kidney.

Usually the symptoms of the diseases under discussion leave scarcely any room for doubt; the sense of uneasiness in the neighborhood of the bladder, the frequent desire to empty the bladder, and

the thick, purulent urine, taken in conjunction with microscopical examinations, will render the diagnosis certain. It is very important to ascertain whether the cystitis is idiopathic or the result of disease of the urethra, prostate, etc., and especially whether a foreign body, such as a calculus, is present in the bladder. It is also important to differentiate spasm of the bladder, which is also attended by pain and frequent micturition; but the quality and the daily quantity of the urine passed remain normal.

There is a series of diseases with bladder manifestations in which no pathological condition exists in the bladder usually diagnosed as cystitis. The bladder symptoms in such are the result of nervous reflexes, principally from an affected posterior urethra, but they may also come from the anterior urethra, from the ureter, and even from the kidney. The diagnosis is often extremely difficult and depends finally on careful local examination. In cases of false cystitis the symptoms are always aggravated by intravesical medication. Guépin and Grandcourt (*Med. Rec.*, Sept. 18, '97).

Differential diagnosis between cystitis and pyelitis: 1. An alkaline reaction is not found with uncomplicated pyelitis. 2. The limit of albumin in the urine even with severest cystitis is 0.1 per cent. (maximum, 0.15). 3. If nearly all the pus-corpuscles are crenated, the condition is pyelitis. 4. If the red corpuscles present are chemically or morphologically decomposed, provided the hæmorrhage is only microscopic and there is no vesical tumor, pyelitis exists. 5. The characteristic symptom for diagnosis is the relation of the albumin-content, which is from 2 to 2½ or even 3 times greater in pyelitis than in cystitis.

Esbach's albuminometer is valuable in determining the amount of albumin. George Rosenfeld (*Berliner klin. Woch.*, July 25, '98).

In polyuria also the urine is voided frequently, but without any pain or purulent sediment. (Lebert.)

Etiology.—Men are more liable than women to vesical catarrh. Traumatism is a frequent cause; injuries, such as blows and pelvic fractures, more particularly of the pubic bone, though both are rather rare conditions. Operations of lithotomy, lithotrity, catheterism, injections; pressure, as in prolonged and instrumental labors, in which class of cases gangrene of the walls of the viscus has been known to ensue, followed by a large vesico-vaginal fistula. Mechanical irritation of foreign substances in the bladder, such as calculi; the poisonous effect of certain drugs, as the chemical action of cantharides and some of the mineral poisons; the action of the urine itself, retained and decomposed, as in stricture and in prostatic enlargement; inflammations of neighboring parts, as the kidneys, prostate, rectum, urethra, and, when so developed, it is in consequence of a pre-existing gonorrhœa, a prostatitis, or the presence of a stricture,—urethral or rectal,—etc.; acute cystitis sometimes develops secondarily in the course of the infectious diseases.

Frequency of cystitis in the course of infectious diseases attacking nursing children: Thirty cases observed all under one year of age; all girls, suffering from broncho-pneumonia, acute gastro-enteritis, meningitis, etc., which nearly always ended fatally. The etiology is nearly always dependent upon retention, the result of the grave general disease. Finkelstein (*Revue Prat. d'Obstet. et de Gynéc.*, July, '97).

Study of bladder affections developing in workers in coal-tar-color factories. Those workers are most liable to strangury and hæmaturia who are engaged in making aniline (amidobenzol), toluidin (amidotoluol), and naphthalin and naphthalamine (amidonaphthalin), and particularly those engaged in preparing fuchsin, which is a combination of aniline and toluidin. There is, however, a distinct individual susceptibility. Otto

Lichtenstern (*Deutsche med. Woch.*, Nov. 10, '98).

Regarding the bacterial origin of cystitis, James Tyson states that the question of whether the obstructive causes enumerated are of themselves sufficient, or whether they may simply supply the conditions favorable to the operation of bacteria, may be considered unsettled at the present day. J. W. White and Edward Martin, on the other hand, hold that all cases of cystitis are undoubtedly due to the presence of pathogenic organisms. Among the organisms capable of producing inflammation may be mentioned the streptococcus pyogenes, staphylococcus pyogenes aureus, diplococcus, bacterium coli commune, tubercle bacilli, etc.

The bacterium coli is one of the most common germs found in cystitis. It may enter the bladder by passing through the urethra, or from the neighborhood through the vesical wall; but it may also enter the blood-vessels and pass out again through the kidneys when the latter are in a morbid state. Thus this bacterium may be a cause of cystitis when predisposing conditions exist. Of 37 cases of cystitis examined, the colon bacillus was found in 13 (12 times solitary); diplococcus ureæ liquefaciens 11 times (9 times solitary); proteus Hauser 5 times (3 times solitary), and staphylococcus pyogenes 4 times (3 times solitary). M. Melchior (*Ugeskrift for Læger*, '97).

Analysis of forty-six cases. Conclusion that cystitis (with certain rare exceptions of chemical or toxic origin) is always due to micro-organisms, the bacterium coli commune being the most common. The mucosa of the bladder, however, must previously be in a condition favorable to infection. Karger (*Centralb. f. Gynäk.*, No. 2, '98).

Lymph-nodules are almost always present in the bladder and the ureters, giving rise at times to a peculiar inflammation personally termed nodular cystitis. Alexander (*Jour. Amer. Med. Assoc.*, May 7, '98).

There is no better method of causing cystitis than the attempt to perform catheterization without full antiseptic precautions. The catheter should never be passed without the exposure and cleansing of the meatus urinarius. The cleansing should be done with bichloride solution 1 to 1000, and a sterilized catheter passed under the guidance of the eye. As a lubricant, the best is boro-glyceride solution. Noble (Gaillard's Med. Jour., Apr., '98).

In cystitis coming on after catheterism in women it seems that the cause of the cystitis is injuries produced in passing the catheter, rather than the use of a dirty one. Walker (N. Y. Med. Jour., Mar. 19, '98).

Cystitis is always caused by the presence of bacteria. The mere presence of bacteria is insufficient to cause cystitis; a further predisposing cause is necessary. Under favorable conditions any pathogenic organism may give rise to cystitis. The entrance of pathogenic organisms into the bladder may be through the urethra, through the ureter from an infected kidney, from inflammatory areas in the neighboring parts, and through the blood-stream and the lymphatics. George T. Howland (Med. News, July 15, '99).

Results of experiments on one hundred dogs: A lesion of the rectum in the vicinity of the prostate, whether superficial or deep, is not followed by cystitis, nor are intestinal bacteria found in the urine in these cases, provided the bladder at the outset is free from disease, and provided also that the rectal lesion is not followed by either general systemic infection or peritonitis. Serious lesions of the rectum may very readily produce general infection, however. Omitting cases of sepsis, cystitis was noted in only one of many cases, and in but one case was there even a transient bacteriuria. Microscopical examination showed that, following the slightest trauma of the epithelial surface of the rectum, numerous bacteria made their way promptly into the lymphatic spaces of the tissue surrounding the rectum, bladder, prostate, and seminal vesicles. If the bladder be injured

by retention at this stage, the pathogenic germs which are sojourning in the neighborhood may succeed in finding entrance and may thus set up a cystitis. Faltin (Centralbl. f. d. Krankh. d. Harn-u. Sexualorgane, Bd. xii, H. 6, 1902).

Pathology.—The changes which are produced by cystitis consist in increased vascularity of the mucous membrane; its light-red color being exchanged for one of a dark-crimson hue throughout, deepening to purple or even black about the neck of the bladder; or the mucous membrane may be ecchymosed, and in places necrotic, and the muscular layer may be exposed. Hemorrhages may occur from bursting veins or separating sloughs; or perforation may occur into the surrounding tissues or into the peritoneal cavity. Peritonitis may arise without actual perforation (John B. Roberts).

In the more chronic cases the epithelium desquamates vary rapidly; mucus at first and then pus is poured out in large quantity. The urine soon becomes alkaline and is putrescent. Blood is frequently present. Decomposition precipitates the salts of the urine and calculi are found in the bladder or a calcareous deposit occurs upon the walls of that viscus. When the disease has been of long duration the muscular wall becomes either hypertrophied and contracted, or its fasciculi become irregularly stretched apart while the mucous membrane sinks into the intervals, giving rise to the condition known as sacculated, or ribbed, bladder. These depressions or sacs may become large and retain decomposed urine, act as receptacles for calculi, or perforate and give rise to peritonitis or perivesical abscess. The ureters and kidneys soon become involved, and add materially to the serious nature of the case.

The commonest cause of infection of the female urinary tract is the bacillus coli communis, which a study of

the cases of acute cystitis definitely proves can and does in a large number of cases set up a true infection without the aid of any other micro-organism. Marked variations are seen in the virulence of this micro-organism and in its pyogenic properties. Other micro-organisms frequently found are the tubercle bacillus, various staphylococci, and the bacillus proteus vulgaris, while numerous varieties of micro-organisms have been less frequently and occasionally met with, as the bacillus pyocyaneus and typhoid bacillus. The proportion of cases of infection due to the bacillus coli communis is greater in women than in men, probably due to the close proximity of the female urethra to the anus. Besides the entrance of the micro-organisms, other factors are in most cases essential to the development of a cystitis; the chief of these factors are anæmia, malnutrition, trauma of and pressure upon the bladder, congestion of the bladder, and retention of urine. In cystitis the chief mode of infection is by the urethra, although one must also consider as possibilities a descending ureteral infection from an infected kidney, pyogenic metastasis by means of the blood- and lymph- currents, and direct transmission of the micro-organisms from the intestinal tract, or from some adjacent focus of infection. In pyelitis and pyelonephritis the usual modes of infection are along the ureter from an infected bladder, and by means of the blood- and lymph- currents; in personal cases these modes of infection were found about equally represented. In the great majority of cases of cystitis, both acute and chronic, and in the majority of cases of pyelitis and pyelonephritis, the urine is acid. In cases in which the urine is ammoniacal the infection can be produced without the aid of any of the accessory etiological factors mentioned above, the irritation of the ammoniacal urine apparently being sufficient to render the bladder susceptible to infection. In infections of the kidney due to a urea-decomposing micro-organism a stone is very likely to be present if the case is at all chronic.

Certain conditions exist which present most of the symptoms of cystitis, but no infection; the most difficult of which to diagnose is probably urinary hyperacidity of neuropathic origin, the successful treatment of which depends upon the successful recognition of both its urinary features and its general basis.

Although the diagnosis of renal infections can be made with absolute certainty only by ureteral catheterization, a probable differentiation between renal and vesical infections can be made by a careful study of the urine alone. Tuberculous infections of the urinary tract frequently occur with no other demonstrable tuberculous lesions elsewhere in the body. Probably a tuberculous gland would be demonstrable post-mortem in most of these cases. The colon bacillus seems to be the commonest cause of pyelitis, while the bacillus proteus vulgaris and members of the staphylococci group are also found less frequently. And finally to be able to thoroughly understand the cases of cystitis, pyelitis, and pyelonephritis brought to our notice, to make the proper diagnosis, to inaugurate and carry out a rational line of treatment, and to give a correct prognosis, a careful chemical and bacteriological study of the urine is absolutely essential. T. R. Brown (Johns Hopkins Hosp. Reports, vol. x, Nos. 1 and 2, 1901).

Prognosis.—The prognosis will depend on the ability of the surgeon to remove the cause and on the duration of the disease. Ordinary acute cystitis, when uncomplicated, is not attended by any great danger. Protracted cases of acute vesical catarrh do occur and may run a very chronic course. The chronic form is to be regarded as troublesome and very intractable, rather than dangerous to life. In young and middle-aged patients, and in those of good constitution, the prognosis is more hopeful and the treatment is more effectual than in those who are advanced in years or enfeebled by disease.

Treatment.—In the acute form the pa-

tient should be ordered to bed at once. The diet should be light and unstimulating: milk, broths, eggs, etc. Stimulants are to be avoided. The bowels should be regulated by the administration of a saline. In point of fact, all such cases are better for the use of some drug as the citrate of magnesia, epsom salt, Hunyadi water, etc., employed to the point of free purgation. Tyson claims that leeches should be applied to the perineum more frequently than they are. If the urine is acid, it should be rendered neutral by alkaline drinks. For this purpose H. C. Bloom recommends Vichy water containing much soda. In most cases the urine is alkaline, though not as frequently in the acute cases as in those that are chronic. The best remedy for neutralizing an alkaline urine is benzoic acid, either administered in solution well diluted with water, or in capsules containing 5 grains of the drug, administering every three hours until the desired result is obtained. Considerable water should be taken after each capsule. When there is much ammoniacal decomposition, salol, in capsules of 5 grains each, given every two hours until the urine is rendered acid, is a valuable remedy. Boric acid, in 10- or 20-grain doses is often efficacious. A weak nitrate-of-silver solution is recommended by some surgeons.

When the urethro-vesical tract is in such a condition that interference can be tolerated, irrigations with a nitrate-of-silver solution, beginning with a strength of 1 to 16,000 and increasing gradually, are effective. This is allowed to flow into the bladder through the anterior urethra by the force of gravity from a fountain-syringe, the height of the receptacle being sufficient to produce enough pressure to overcome the resistance of the cut-off muscle. So soon as the patient feels the tension of the fluid in the bladder the flow is discontinued and the patient is directed to stand and empty the viscus. These irri-

gations may be given every day, or every second day, as the patient's symptoms may indicate. Ramon Guitéras (*N. Y. Med. Jour.*, Mar. 19, '98).

In cystitis the first and main indication for treatment must be to render the urine antiseptic. Urotropin is a non-toxic and non-irritating derivative of formic aldehyde. In cases of cystitis and of phosphaturia its action has personally been almost specific. In some cases it causes a slight burning sensation in the bladder if large doses are taken, but no patient to whom it has been personally given has ever complained of this. In prescribing urotropin the reaction of the urine should first be discovered. If it is very acid a little citrate or acetate of potassium, or if it is very alkaline a little dilute mineral acid should be given in addition to the drug. T. G. Kelly (*Therap.*, Oct. 15, '98).

The value of urotropin depends more on whether (1) the cystitis, as a primary bacterial invasion, develops in a healthy urinary tract, in which condition 40 per cent. were personally cured, and 60 per cent. improved, or (2) whether it associates itself with a pre-existing disease of the tract, as stricture, hypertrophied prostate, tumor, paresis, nephrolithiasis, tuberculosis, gonorrhœa, etc. In these cases urotropin alone is useless, yet combined with local treatment, while there is little hope of cure, there may be much alleviation of the symptoms (in 49 cases, 4 cured and 30 improved). If (3) the cystitis is secondary to an infection of the urine, urotropin, like santal and salol, is utterly useless (10 cases, 10 failures). B. Goldberg (*Centralb. f. innere Med.*, July 14, 1900).

In cases where the inflammation is too acute to tolerate irrigations, instillations of nitrate of silver are of great value. They should be given with the Ultzmann or the Otis syringe, beginning with a strength of a grain to the ounce and increasing the strength to ten grains if necessary. From 5 to 20 drops of such a solution may be employed at one time.

Girl of 19, under treatment for gonorrhœa which had distinctly involved the

uterine mucous membrane, began to complain of pain during micturition. On examining the urine gonococci were detected in pure culture. Through the cystoscope the vesical mucosa appeared very vascular, with superficial loss of substance at certain points. The cystitis was cured by washing out the bladder with warm boric lotion and injection of a 1-per-cent. solution of nitrate of silver. Lindholm (*Cent. f. Gyn.*, No. 21, '97).

Pyoktanin can be applied to the most delicate mucous membrane, not only in concentrated solution, but in powdered form with but slight, if any, irritation. It retards the development of pus even in solutions of 1 to 2000. When applied to inflamed mucous membrane, it stains it intensely blue; this color remains for a number of days. It is active as an antiseptic as long as any color remains. In treatment of inflammation of the bladder and urethra injections of pyoktanin solutions into the bladder produced the happiest results in four cases. R. E. Graham (*N. Y. Med. Jour.*, vol. lxvii, p. 889).

Irrigations and injections of perman-ganate of potash in $\frac{1}{12}$ - to $\frac{1}{4}$ -per-cent. solution is a most excellent remedy. In employing vesical irrigation it is important to observe the strictest attention to the cleanliness of all instruments used. Large injections should not be used. Better an ounce or so at a time frequently repeated, until the washings come away perfectly clear. The temperature of the solution should be about 100° to 105° F. When there are local causes for reflex irritability, as hæmorrhoids, varicocele, phimosis, adherent prepuce, or a narrow meatus, appropriate surgical treatment should be resorted to. Urethral causes of irritability of the bladder or of partial retention of the urine, such as stricture of either large or small calibre should be promptly attended to. (White and Martin.)

In chronic cystitis, whatever be its origin, the treatment of the inflammation of the bladder should be by both

local and internal medication until it is in a condition that will permit of more radical measures.

Operative interference is indicated when the symptoms of pain and frequency are very severe, and when no improvement has resulted from general and local treatment: distinctly, therefore, a more serious group of cases. Curetting the bladder, through the perineum in the male and through the urethra in the female, followed by thorough drainage, has yielded the best results. The perineal route is preferred, because it is easier, because it gives readier access to the usual situation of tubercle in the bladder, and because the drainage it affords is the best. The only advantage of the suprapubic method is that of allowing one to see the seat and extent of the lesion. Banzet (*Ann. d. Mal. d. Org. Génito-Urin.*, June, '97).

In women the lesions of cystitis are, in reality, more frequently localized around the neck of the uterus and of the trigonum, and for a long time they are rather superficial. It is only in extreme cases that the condition of interstitial cystitis, which seems to be beyond therapeutic resources, becomes established. In such cases amelioration is very distinct after vesical curetting. The operation is very simple and preceded by thorough lavage of the bladder. For this a solution of boric acid is used to which 1 per cent. of a solution of corrosive sublimate of the strength of 1 to 1000 without alcohol is added.

According to Guyon, this intervention does not completely cure the cystitis, but it renders the disease more amenable to other methods of topical treatment which before could not be tolerated.

Treatment may be summed up as follows: Treatment of the uterus and its adnexa and general treatment. Local treatment of cystitis, although easy in light cases, becomes insufficient in pronounced cases. Surgical treatment becomes necessary in cases in which the pain is intense. Cystotomy, particularly colpoecystotomy, should be reserved for very serious cases. Very often recovery or a step toward recovery, by means

of local topical treatment, may be obtained by curetting the bladder through the urethra. This operation is simple and easy; it does not require any complementary operation, and it gives excellent results. M. G. Camero (*Gaz. Heb. de Méd. et de Chir.*, Sept., '97).

The use of the curette advocated in cases of non-tuberculous chronic cystitis that will not yield to ordinary treatment, or even the radical surgical means, such as drainage of the bladder by either the perineal or suprapubic routes. N. W. Soble (*Buffalo Med. Jour.*, May, 1900).

In chronic cystitis in the female sublimate instillations will often produce a very great improvement in the distressing symptoms met with in both tuberculous and non-tuberculous cystitis. In some cases a complete cure may be obtained when the instillations fail to produce the desired effect by curettement of the bladder in both tuberculous and non-tuberculous cystitis; in gonorrhœal cystitis instillations of sublimate are particularly efficacious; under favorable circumstances a radical cure of tuberculous cystitis may be obtained by curettement when the vesical lesions are localized and the kidneys free from the disease. When the lesions are extensive, they should be directly treated by suprapubic cystotomy. When cystitis is caused by a prolapsus of the genital organs, and when hysteropexy, combined with anterior and posterior colporrhaphy does not relieve the bladder symptoms, curettement of the bladder, followed by sublimate instillations, is the proper treatment. C. G. Cumston (*N. Y. Med. Jour.*, Sept. 22, 1900).

The next step is to remove the cause of the trouble, if discoverable. Strictures of the urethra must be dilated, for eign bodies must be removed, retention of the urine from enlargement of the prostate or paralysis, etc., must be treated by the regular use of the catheter and then by such operative interference as is deemed best suited to the individual case.

A soft catheter should be used and as often as the viscus will allow without

adding to the irritability present, twice or three times in the twenty-four hours not being too frequent.

A large percentage of female patients suffering with subacute vesical symptoms—as painful micturition, bearing-down sensation, and a feeling that the bladder is not emptied after micturition—can be readily relieved by dilatation of the urethra. The greatest amount of practical good that has been obtained in bladder troubles is by the use of the cystoscope. J. M. Baldy (*Phila. Polyclinic*, No. 18, p. 100, '95).

The ordinary bougie, either metallic or soft, can be rendered sterile by washing carefully and drying with a towel or gauze rendered sterile by boiling. The use of antiseptic solutions is unnecessary. As soon as they become scratched or injured, metal bougies should be polished and replated, while soft ones must be thrown away. Metal or Jaques's soft-rubber catheters can be rendered positively sterile by boiling or washing, and soaking in strong antiseptic solutions that do not injure them. It is impossible to render gum-elastic or varnished catheters sterile when, for any reason, they have to be employed. A gum-elastic catheter that is smooth and well finished inside may be rendered reasonably secure by having the patient hold it for a time under a tap and then lay it aside immersed in a boric solution, a weak perchloride, or other weak antiseptic solution. When the urine is purulent or septic, the catheter must be destroyed if it is not metal or soft rubber. Where there is not much pus or infection, it can be washed, immersed in antiseptic solutions, and steamed internally. Nicoll (*Annals of Surg.*, June, '99).

The best internal remedies,—i.e., those usually praised—are benzoic acid, about 30 grains a day in divided doses; benzoate of sodium, 10 grains four times a day; salol, in a similar dosage; and urotropin, $7\frac{1}{2}$ grains three or four times a day, well diluted with water.

If there is residual urine in the bladder, it is only a question of time as to

when that urine will decompose and give rise to cystitis. Women seldom completely empty the bladder while lying perfectly flat on the back. Hence, when, on account of illness, they are placed on the back sufficiently long, cystitis may occur. Cases cited in which cystitis supervened after an interval of ten days, and in another as soon as three days after operation. In appropriate cases, the recumbent posture should be changed to the sitting posture when at all possible. To correct the offensive odor, salol and betol are useful. A dose of 5 grains, three times daily, of betol, will, as a rule, completely correct the odor in twenty-four to thirty-six hours. W. H. Bennett (*Clinical Jour.*, Mar. 27, '95).

In gonorrhœal cystitis, rest in bed, avoidance of all local irritations, administration of morphine, codeine rectal suppositories, or of extract of hyoscyamus, use of local warm baths; forbidding of spices, alcohol, and carbonated waters, and the giving of laxatives. Priapism can be avoided by the bromides, with camphor or cannabis Indica. For the cystitis itself, salol, in three doses of 15 grains each, sodium salicylate, or sodium benzoate are useful. If the digestion is excellent, oil of santal, cubeb, kava-kava, balsam of copaiba, balsam of Peru, and oil of turpentine may be employed. Of importance is the use of infusions, as of uva ursi, quite likely on account of their diluting the urine. M. Harovitz (*Centralb. f. d. Gesamte Therapie*, H. 2, S. 65, '97).

Bladder lavage with salt-water, and the application of oil containing iodoform and guaiacol, is a method suggested by the good effects which artificial serum produces in tuberculosis of the peritoneum, as well as the generalized and stimulating action which it exercises upon the nutrition of the tissues. The physiological solution of chloride of sodium was left in the bladder in considerable quantity, directing the patient to hold it as long as possible. To produce a tolerance by the bladder, olive-oil containing 5 per cent. of guaiacol and from 1 to 2 per cent. of iodoform was

injected. The iodoform deposits itself upon the mucous membrane, especially at the points of ulceration, and thus forms a kind of protective film. These applications are attended with the irrigations with normal salt solution. The pain, bleeding, and other well-known symptoms of this disease soon disappear. A. Montford (*La Semaine Médicale*, Dec. 10, 1902).

The patient should be advised to drink freely of water and should be careful regarding diet. Locally the bladder should be washed out once or twice a day with a solution of permanganate of potash $\frac{1}{4000}$ to $\frac{1}{5000}$; silver nitrate in a similar strength; boric acid, 10 grains to the ounce; bichloride of mercury, $\frac{1}{4000}$ to $\frac{1}{500}$.

In cystitis due to enlarged prostate the question of operation has to be considered, and includes such procedures as castration (White's operation); resection of a portion of the vas deferens; enucleation of the prostate; incisions of the prostate (Bottini's method), etc.

Anodynes are indispensable in many cases of cystitis to relieve the frequent desire to urinate and the extreme pain the patient suffers. They are best given per rectum and in the form of opium or its alkaloids. Many cases demanding operation for the relief of the distressing symptoms inevitably associated with chronic inflammation of the bladder are only relieved by such measures as a suprapubic cystotomy or a perineal section.

[The severe pain attending the passage of urine is often relieved by the use of 5-grain doses of chloride of ammonium every three hours, especially if litmus-paper show the urine to be acid. ED.]

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D

DACRYOADENITIS. See LACRYMAL APPARATUS.

DACRYOCYSTITIS. See LACRYMAL APPARATUS.

DANDRUFF. See SEBORRŒA.

DEAF-MUTISM.

Definition.—Deaf-mutism, strictly speaking, signifies the abnormality which is characterized by the co-existence of deafness and dumbness. Various circumstances, which will be treated of in the following pages, necessitate, however, a more limited definition. Deaf-mutism may, therefore, be defined as a pathological condition dependent upon an anomaly of the auditory organs, either congenital or acquired in early childhood, causing so considerable a diminution of the power of hearing as to prevent the acquisition of speech, or—should speech have been acquired before the occurrence of the loss of hearing—as to prevent its preservation by the aid of hearing alone. Persons exhibiting this pathological condition are described as deaf-mutes, even when speech has been acquired by a special system of instruction.

Theoretically, deaf-mutism is an ill-defined condition, which cannot be distinctly separated from other conditions related to it. This is a natural consequence of its being a pathological term founded, not only upon a symptom, deafness, but also upon the intensity of that symptom and the period of its occurrence. There is, also, an apparent contradiction in the fact that deaf-mutes include, not only those who cannot, but, also, those who can, hear or speak. Practically, however, there is seldom any dif-

ficulty in determining whether a person is or is not a deaf-mute, just as it is, also, as a rule, easy to recognize deaf-mutism, when the subject in question has passed the first years of infancy. The reason is that the acquisition and preservation of speech in childhood is so dependent upon hearing that, as soon as the latter sinks below a certain degree, the former cannot be developed, or is lost, and this secondary dumbness does not easily escape observation. Occasionally, it may be difficult to decide whether a child should be described as a deaf-mute or as merely deficient in hearing and speaking. Such cases must be decided by purely practical considerations, and it may not be out of the way to observe that in Denmark—one of the few countries where the education of deaf-mutes is compulsory—all children are considered deaf-mutes who cannot, owing to their deficient hearing, take part in the instruction given to normal children.

Classification.—Deaf-mutism can be classified (1) either according to the degree of its symptoms, or (2) according to its etiology. In the first case a distinction must be made according as the deafness or dumbness is absolute or not. *True deaf-mutism* may be described as being the state in which the hearing is positively *nil*, and in which there is no power of speech, unless it be acquired by a special method of instruction. Persons with this form of deafness may be designated as true deaf-mutes. Those who have some slight power of hearing or some power of speech (either because the hearing is not totally absent or because the deafness occurred after speech had been acquired) may be described as *semi-mutes*.

Etiologically, deaf-mutism has been

further divided into *endemic deaf-mutism* (i.e., that which attaches to certain districts and their natural conditions) and *sporadic deaf-mutism* (which is the result of certain accidental causes).

The most general classification of deaf-mutism is that which discriminates be-

the cases of deaf-mutism are caused by acquired deafness. The relative proportion must, however, vary very much in different places and at different periods, epidemics of certain infectious diseases, for instance, increasing the absolute number of deaf-mutes with acquired

DISTRIBUTION OF DEAF-MUTES IN VARIOUS COUNTRIES.

	Country.	Year.	Number of Deaf-mutes per 100,000 Inhabitants.	Total Number of Deaf-mutes.	Proportion between Male and Female Deaf-mutes.
<i>Europe :</i>					
	Switzerland	1870	245	6,544	
	Austria	1890	123	29,217	100:74
	Baden	1871	122	1,784	100:89
	Sweden	1895	116	5,307	100:90
	Alsace and Lorraine....	1871	111	1,724	100:76
	Württemberg	1861	111	1,910	100:87
	Hungary	1890	109	19,024	100:84
	Norway	1891	106	2,139	100:81
	Prussia	1880	102	27,794	100:83
	Finland	1880	102	2,098	100:77
	Bavaria	1871	90	4,381	100:94
	Ireland	1880	77	3,993	100:87
	Portugal	1878	75	3,109	100:73
	Greece	1879	65	1,085	
	Denmark	1890	65	1,411	100:89
	France	1876	58	11,460	100:87
	Saxony	1890	57	1,994	100:85
	Scotland	1881	57	2,142	100:86
	Italy	1881	54	15,300	100:76
	England-Wales	1891	50	14,112	100:83
	Spain	1877	46	4,625	100:65
	Belgium	1875	43	1,208	100:89
	Holland	1889	43	1,977	100:81
<i>America :</i>					
	Canada	1891	100	4,819	100:86
	United States.....	1890	66	41,283	100:81
<i>Africa :</i>					
	Cape Colony.....	1890	53	802	100:78
<i>Asia :</i>					
	British India.....	1891	69	196,843	100:64
<i>Australia :</i>					
	English Colonies.....	1891	37	1,412	

tween the deaf-mutism resulting from *congenital* pathological changes of the organs of hearing and that resulting from such changes which are *acquired* after birth.

We have reason to surmise, according to modern statistics, that at least half

deafness. Future investigations will, perhaps, prove that acquired deafness has a still greater preponderance in the causation of deaf-mutism than we are at present authorized in believing.

Distribution.—We are only in possession of information as to the distribution

of deaf-mutism in Europe, the United States of America, and some European colonies. Not even all European countries have undertaken an enumeration of their deaf-mute population; Russia, the largest of them, having, for instance, no deaf-mute statistics. The table on page 439, which includes the most recent enumeration of deaf-mutes, gives their numbers in different countries, also the proportion of males and females.

It will be seen from this table that deaf-mutism is very variously distributed in the countries from which we possess statistics. The causes of the remarkably unequal geographical distribution of deaf-mutism, which will be seen from the table, are probably numerous and various. To begin with, we are involuntarily struck by the fact that the European countries, with large deaf-mute population, are the most mountainous, which is in perfect accord with the fact that deaf-mutism is more frequent in mountainous than in lowland districts. I shall later on have occasion to point out that this is not, in all probability, the result of great altitudes and peculiar geological formations, but of the unfavorable social and hygienic conditions common to mountainous countries (consanguinity, poverty, unhealthy dwellings, etc.), the importance of which as causes of deaf-mutism will be discussed afterward. Further, wide-spread and malignant epidemics of cerebrospinal meningitis, an important cause of deaf-mutism, explain the frequency of this condition in the lowland countries of Central Europe.

We must, also, observe that the countries in the west and south of Europe are the most fertile and productive, while those in the north and centre are less favorably endowed by nature. That this circumstance is a factor in the distribution of deaf-mutism has been proved by

investigations made in different districts in Denmark, and especially in Saxony. Finally, the northern and central countries are, on the whole, the most thinly populated in Europe, doubtless the result of the barrenness of the soil.

Sex.—The table on page 439 shows a greater frequency of deaf-mutism among males than females, the difference in several countries being considerable. The number of female deaf-mutes per 100 male deaf-mutes varies, according to the table, from 94 in Bavaria to 65 in Spain, the average rate in Europe and the United States of America being 82 females per 100 males. The numerical superiority of male deaf-mutes is the more remarkable since females are more numerous than males in nearly all the European countries, Italy being the only country of those mentioned in the table which exhibits a slight inferiority as regards the female population. This numerical superiority of the male deaf-mutes must undoubtedly be considered principally as an expression of the greater liability the male organ of hearing has to be morbidly affected.

Symptoms and Sequelæ.—Of the symptoms, the principal are, of course, deafness and dumbness; but other symptoms closely connected with the ear disease causing deafness are often met with in cases of deaf-mutism.

DEAFNESS.—The term "deafness" is not only used to express the absolute absence of hearing,—total deafness,—but also to express a condition in which some traces of hearing remain, but in which the human voice is not audible in the usual way: a condition to be described as partial deafness. From a theoretical point of view, it seems an easy matter to make a sharp distinction between the condition in which the auditory nerve is entirely out of function and that in

which it still acts, though deficiently. As a matter of fact, however, it has been proved that it is sometimes difficult to decide, in particular cases, whether there are any remains of hearing or not; and, further, the results of these two conditions (if acquired in early infancy or congenital) are the same, viz.: deaf-mutism. In other words, both subjects with total deafness and those with partial deafness may be met with among deaf-mutes.

It is not always an easy matter to test and decide the amount of hearing possessed by a child, especially an infant. As a rule, only ordinary loud sources of sound can be employed to discover whether the child in question reacts in any way to the sound produced; for instance, by turning or blinking its eyes. Generally, a loud whistle, a bell, clapping the hands, or such like devices are made use of. Such a rough mode of examination can, however, only decide whether the power of hearing exists or not in individual cases, and even this is often difficult when the patient is an infant, and it is also no easy matter to determine whether the power of hearing is equal on both sides. With older children it is easier to discover whether the power of hearing exists, and, if so, in what degree. In the latter case less powerful sources of sound may be employed. Of these the principal is the tuning-fork, the vibrations of which are used in measuring the conduction of sound through the middle ear, by placing it outside the ear; and also in measuring the so-called bone, or cranio-tympanic, conduction, by placing it on the mastoid process or on the teeth. The human voice is also an important means of investigation. The best means of employing it is by pronouncing certain vowels loudly and distinctly close to the deaf-

mute's ear, without his being able to see the movement of the lips, the patient being asked to repeat the vowels pronounced. To prevent the possibility of guessing the vowels should be repeated several times. If the deaf-mute understands the vowels easily, consonants and even words and short sentences may be tried. In most cases this method can only be made use of when the deaf-mute in question has learned to articulate. A greater power of hearing is seldom met with, unless sound-increasing apparatus are employed. The hearing of deaf-mutes with considerable remains of hearing can also be tested with a loud-ticking watch placed outside the ear or pressed against the outer ear. It is, however, very unusual for deaf-mutes to be able to distinguish the high notes represented by the ticking of a watch. In employing all these methods, it must be remembered that the hearing of deaf-mutes differs greatly at different times in some cases, according to varying conditions in the ear, of which we have no immediate knowledge.

The reports of various investigators, as to the relative number of deaf-mutes with total deafness, differ considerably, for, while some have found that only about one-fourth of the deaf-mutes examined were totally deaf, others have found a much larger proportion, the principal cause of this discrepancy being probably the fact that there is generally a distinct relationship between the deafness and its cause. This relationship is most distinctly seen by comparing the power of hearing of congenital deaf-mutes with that of deaf-mutes with acquired deafness. All investigators, with a few exceptions, have, namely, found a much greater number of cases of total deafness among deaf-mutes with ac-

quired deafness than among deaf-mutes with congenital deafness.

The reason why so many more cases of total deafness are met with among deaf-mutes with acquired deafness than among those with congenital deafness is owed to the fact that post-natal processes in the ear causing deafness are much more destructive than the same processes occurring during foetal life: a circumstance which has been previously pointed out. Most authors have also found that congenital deaf-mutes are more frequently in possession of a considerable degree of hearing (hearing of vowels or even of words) than deaf-mutes with acquired deafness.

It may be mentioned, finally, that Bezold examined the hearing power of deaf-mutes by means of a graduated series of tuning-forks and found that frequently "islands" of perception of notes alternated with total defects of hearing. These defects appeared most frequently in the lower end of the scale—a fact which has been corroborated by Uchermann.

MUTISM.—Mutism was in early times believed to be the primary and essential symptom of deaf-mutism, but it is known now to be a secondary phenomena which is the consequence of the deafness. That this is the case is also evident, from the fact that the degree of mutism is, as a rule, in exact relation to the degree of deafness, and also to the period at which the deafness makes its appearance. Thus congenital deafness, or deafness acquired in early infancy, is always accompanied by complete mutism (excepting in cases in which the mutism is removed by special methods of education), while in cases of acquired deafness, in which the deafness is either not total or arises after the child has learned to speak, a certain degree of speech is respectively acquired

or retained. The explanation is simple, speech being, under normal circumstances, acquired through the ear, the child imitating the words which it hears spoken by those about it. It may, however, be mentioned that even children totally devoid of hearing produce sounds which sometimes resemble words, such as "ma-ma," "ba-ba," etc., and sometimes also imitate animals, often thus causing their friends to suppose that they are capable of hearing. This may be because the above-mentioned sounds and the voices of certain animals are produced by very simple movements of the vocal organs which can be imitated by spontaneous observation. Finally, it is possible that the vibrations caused by such loud sounds as the barking of a dog, bellowing of a cow, etc., may be perceived by the aid of touch, which sense is often highly developed in deaf children, and consequently guides them in imitating the sounds.

The question as to the degree of deafness which must exist, or, in acquired cases, the age at which the deafness must appear in order to cause mutism resulting in deaf-mutism, cannot be answered decidedly. To begin with, the application of the term "deaf-mutism" is entirely arbitrary in cases in which there is some power of hearing or of speech, and the distinction between a deaf-mute child and a child with deficient power of hearing must in some cases depend entirely upon practical considerations, of which the method of instruction which is requisite for the child's education is, as a rule, decisive. Thus, for instance, a child of well-to-do parents, who is able to hear tunes and to a certain extent reproduce them, will scarcely be considered deaf and dumb and sent to an asylum, while a child with the same degree of hearing, but of poor parents, will be treated as a

deaf-mute, because the parents are unable to give it the special education which it requires. The non-development or deficient development of the power of speech in cases of congenital partial deafness, and its complete or partial loss in cases of acquired deafness, are also often dependent upon the assiduity with which a child's friends attend to its development or preservation. Some children, too, seem to have a greater aptitude for developing or retaining the power of speech than others, and this seems to be not only dependent upon their intellectual faculties, but also upon other unknown conditions. Thus, a child with comparatively very slight power of hearing, or with deafness acquired soon after birth, may exhibit a comparatively considerable power of speech, while another child with greater powers of hearing and later acquired deafness may be entirely without it.

Future investigations will in all probability decide how far total acquired deafness results in total mutism. Hartmann states that deafness acquired before the age of seven causes secondary mutism, and this opinion is, no doubt, correct. On the other hand, there are reports from various places to the effect that deaf-mutism may appear at the age of 14 or 15 or even later. In these cases, however, it is probable that the term deaf-mutism is incorrect, though, of course, such accidental circumstances as feeble-mindedness, blindness, etc., may necessitate the registration of persons who have lost the power of hearing so late in life as deaf-mutes, because they are unable to read from the lips, or unable to pronounce so distinctly as to be understood.

As mentioned above, mutism in deaf-mutes may be either total—*i.e.*, the power of speech may be entirely wanting—or it may be partial, in which latter case the

power of speech is developed, or, in acquired deaf-mutism, it is retained to a certain extent. This power of speech is frequently considerable; so that such persons cannot, properly speaking, be termed mutes. There are, however, certain peculiarities which always attach themselves to the speech even of persons who are only partially deaf from their birth, or who have become deaf during childhood. These peculiarities, which are still more pronounced in true deaf-mutes, consist in the absence of accentuation of syllables and of words, the result being that speech becomes monotonous. Besides this, the speech of such persons is generally dull-sounding and feeble, and the control of respiration is also deficient. The stock of words is also sometimes limited, though this peculiarity is, under ordinary circumstances, not very noticeable, excepting in cases where the power of hearing is very slight, or where the deafness appears comparatively early. These physical deficiencies in the speech of deaf-mutes are easily accounted for, because the power of hearing is not only important in the development of speech by enabling a child to imitate the speech of others, but it also enables it to regulate the modulation, sound, and force of its voice by the aid of the vibrations which reach the labyrinth through the bones of the cranium.

The power of hearing plays so great a part in the above-mentioned physical qualities of speech that its loss cannot be completely compensated for by any other sense. It is, however, possible, by aid of sight and touch, to teach a great number of deaf-mutes to speak well enough to be able to use speech as a means of communication. Persons who have been totally deaf from birth can also be taught, by a special method of instruction, to speak so that they can be

understood, though with the peculiarities above mentioned. Owing to these peculiarities, such speech has received the name of "articulation." It is not always an easy matter for the deaf-mute to retain the power of speech which he has gained with so much difficulty, when he enters the world and comes in contact with persons who cannot, or can only partially, understand him. In such cases the deaf-mute generally abandons the use of speech as a means of communication, especially as lip-reading requires great attention and well-developed sight.

DISTURBANCES OF THE EQUILIBRIUM.

—It has been mentioned that acquired deafness is often accompanied by disturbances of the equilibrium, both at its first appearance and immediately afterward, and that this complication is most frequent in cases where the deafness has been caused by cerebrospinal meningitis. Mention is also made in literature of some few cases of congenital deafness accompanied by disturbances of the equilibrium, consisting in uncertain and staggering gait, both during the first years of childhood and later on in life. James was the first to draw attention to "immunity from dizziness," under circumstances which otherwise produce dizziness and consequent disturbance of the equilibrium, as characteristic of deaf-mutes. He examined altogether 519 deaf-mutes and found that 186—*i.e.*, 36 per cent.—did not feel the least dizziness when spun round rapidly, no matter in what position their heads were placed. James was also informed by many of these deaf-mutes that they experienced a remarkable feeling of helplessness and want of sense of locality when under water, several of them also stating that these sensations were unknown to them before the loss of hearing. Kreidl endeavored to discover in a more rational

manner, and by the aid of a specially-constructed apparatus, an objective proof of the above-mentioned phenomena in deaf-mutes, and also to decide their nature and strength. Pollak endeavored to produce dizziness in a number of deaf-mutes by conducting a galvanic current through their heads. Several exhibited signs of dizziness, accompanied by movements of the head and eyes, also exhibited by normal subjects under like circumstances, while 29.3 per cent. were not affected in any way; in these, then, it was to be supposed that the semicircular canals were entirely destroyed, and Pollak points out the resemblance between the figures thus obtained and the percentage of cases of entire absence or destruction of the semicircular canals found by post-mortem examination of deaf-mutes.

Although deaf-mutism brings with it a long train of indirect consequences, which are of great importance as affecting the daily life of the deaf-mute, its more direct results are but few, and even these are the subject of dispute.

DEFICIENT DEVELOPMENT OF THE MENTAL FACULTIES.—There can be no doubt that the want of such an important sense as hearing must at least result in a slow development of the mental faculties, as the psychological function of the brain develops not only in proportion to its receptivity to impressions from without, which are so necessary for mental growth ("*nihil est in intellectu quod non antea fuerit in sensibus*"), and to the quality of these impressions, but also in proportion to their quantity, which must of necessity be diminished when one of the routes by which they reach the brain is closed or partly closed. This does not, of course, prevent a deaf-mute from attaining the same degree of intellectual development as a normal

person with the same amount of intelligence, if his physical deficiency is compensated for by energy, industry, etc. There is, however, no doubt that purely practical considerations—for instance, the necessarily-limited choice of professions—often hinder such a complete indemnification for the loss of so important a sense as hearing. The deaf-mute is thus deprived of one of the most important incentives to energy,—namely, ambition; and it is, doubtless, in these external hindrances, that the reasons are to be sought why no deaf-mute has as yet written his name on the pages of history. Further, the morbid processes causing deaf-mutism often have their seat in the brain, as has been already pointed out, and these processes often leave other traces behind them. Hartmann found also that one-half of the pupils examined by him in deaf-and-dumb asylums, whose deafness was due to brain disease, were but moderately or indifferently endowed with intelligence, and it was altogether doubtful whether many of these subjects were capable of instruction. There are also statistical proofs from other countries that deaf-mutism is often accompanied by want of mental power. It is not, however, correct to infer that deaf-mutism can result in idiocy from the circumstance that deaf-mutes are often idiots. Idiocy, when it appears simultaneously with deaf-mutism, is the result of a congenital brain disease, or one acquired in infancy, and is of superior or co-ordinate importance to the deaf-mutism itself; persons exhibiting both these abnormalities must, doubtless, not be considered as idiotic deaf-mutes, but as deaf-and-dumb idiots. H. Schmaltz and Lemcke have made some measurements of the heads of deaf-mutes in order to elucidate the question as to the intelligence possessed

by deaf-mutes. Both these investigators found that the heads of deaf-mute children were, as a rule, smaller than the heads of normal children, especially in the younger age-periods. The reason is, doubtless, that the mental faculties of deaf-mute children are less developed than those of other children.

ABNORMALITIES OF THE EAR FOUND BY OBJECTIVE EXAMINATION. — While the section of this paper on morbid anatomy will be mainly devoted to the pathological changes of the deeper parts of the ear, it is my purpose, under this heading, to deal with the abnormalities found in those parts of the ear which are accessible to objective examination. It would naturally be supposed that as deaf-mutism is often caused by anomalies of the ear, deaf-mutes would often exhibit congenital abnormalities of the external ear. This is, however, not the case, as congenital malformations of the external ear are but seldom met with. A close investigation of the cases of malformation of the external ear reported in literature proves also that these abnormalities are but very rarely accompanied by such a diminution of the powers of hearing as to result in deaf-mutism, which circumstance has been laid much stress upon by Toynbee. Abnormalities of the external meatus have been often met with. It is, however, often difficult to decide the nature of the abnormalities from the descriptions of them we possess, and a comparison of the frequency with which they have been found by various investigators is, therefore, of no interest. Contraction of the meatus would seem to be the abnormality most frequently met with. The greatest interest, however, attaches to the closing of this passage, which has been found by many investigators without being accompanied by any malformation of the external ear.

There can be little doubt that when the meatus is closed by a membrane situated close to the external ear this is due to congenital malformation; should the membrane, however, be situated in the neighborhood of the tympanum, it is possible that the obstruction is the result of inflammation in the tympanic cavity. I have, at least, in two cases, observed such a closing of the external meatus of deaf-mutes resulting from scarlatinal inflammation, in the one case on both sides, in the other on one.

As to otoscopic examinations of deaf-mutes, these have contributed very little to the pathogenesis or etiology of deaf-mutism. Such investigations have been published by various authors, whose researches, in spite of the care which has been bestowed upon them, have led to very little result; in fact, the various authors differ very considerably in the results obtained. The difference observed in the results of examinations of normal children and pupils at deaf-and-dumb asylums lies in the greater frequency with which the abnormalities found appeared in deaf-mutes, and not in the nature and kind of these abnormalities. All investigators who have classified the deaf-mutes examined by them according to the nature of their deafness (congenital, acquired, or doubtful) agree that the otoscopic examination of the drum-heads in cases of congenital deafness yields a negative result more frequently than in cases of acquired deafness, the latter more frequently exhibiting destructive inflammatory processes or the traces of such.

ABNORMALITIES OF THE MUCOUS MEMBRANES ADJACENT TO THE EAR.—Catarrhal changes of the mucous membranes of the nose, naso-pharynx, and pharynx have been frequently observed. These changes have most frequently

taken the form of hypertrophy of the whole mucous membrane, or of the adenoid tissue (adenoid vegetations, hypertrophy and hyperplasia of the tonsils), less frequently the form of atrophy (ozæna, atrophic catarrh of the naso-pharynx and pharynx). The frequency with which catarrhal changes of the upper air-tract has been observed by investigators differs greatly. The cause is doubtless to be sought in the circumstance that catarrhal diseases of the nose, naso-pharynx, and pharynx appear with varying frequency in different countries and in different classes of society, as climate, mode of living, clothing, hygienic conditions, etc., as is well known, play an important part in the appearance of catarrh in the air-passages. The results of such examinations of deaf-mutes will, therefore, first be of use in judging of the relation of such affections to deaf-mutism, when we possess information as to the frequency with which catarrhal diseases of the upper air-passages appear in normal subjects of the same age and living under the same conditions as the deaf-mutes from which to draw comparison. It seems, however, to be, beyond doubt, that deaf-mutes suffer with great frequency from adenoid vegetations of the naso-pharynx.

ABNORMALITIES OF THE EYE.—Although we find several notices of abnormalities of the eyes of deaf-mutes, it is often difficult to decide whether these are accidental phenomena or connected etiologically with deaf-mutism. Among the abnormalities of the latter category may be mentioned retinitis pigmentosa, various malformations of the eye; atrophy of the bulb caused by panophthalmia, a result of the same acute disease as caused the deafness; finally syphilitic interstitial keratitis.

Diagnosis. — Although deaf-mutism

from a theoretical point of view is not a very distinctly-defined condition, still the majority of cases are easily recognized. The question whether a person is a deaf-mute or not must, according to what has been laid down in the foregoing pages, be principally decided by examinations as to the function of the auditory nerve. If this is entirely suspended, or so reduced that speech cannot be heard, and if the history of the case proves that this condition dates from birth or infancy, then the subject must be regarded as a deaf-mute. We are also justified in applying this term, as has already been pointed out, even where there exists some power of speech either acquired by special means of instruction or where the deaf-mutism has appeared at a more advanced age, retained to a greater or less extent. The circumstance that the pathological condition called deaf-mutism is based upon a symptom, the extent of which cannot be measured with any degree of certainty, but which, nevertheless, is decisive, naturally causes arbitrary decisions in some cases, which decisions generally depend upon purely practical considerations. In other words, there are persons as to whom it is difficult to say with certainty whether they are deaf-mutes or not. Such are persons who can hear the human voice to a certain extent, and who consequently learn to articulate by the aid of special methods of education, or such as have lost the power of hearing so late that they have retained the power of speech, although their voice is always somewhat peculiar. Such persons are, however, but few in number, and consequently the difficulty in diagnosing deaf-mutism mentioned here is of very slight practical importance.

Of much greater importance are the difficulties which present themselves

when the person in question is an infant. It must, however, be pointed out that the term "deaf-mute" is incorrect when applied to children under a year old, as no children can speak at that age. It would seem, indeed, that great caution must be observed in drawing the conclusion that deaf-mutism will necessarily be the result of even total deafness observed during the first year of infancy, since, according to the experience of many etiologists there are some children who are unable to react, or who react very slowly, to sounds during the first year of infancy, but whose hearing, nevertheless, when older, is perfectly normal. In any case it is extremely difficult to arrive at any decided opinion whether an infant possesses the power of hearing or not, and especially as to what degree of hearing it possesses, and, as a rule, the younger the child, the greater is this difficulty. The reason is, doubtless, that the sound-conducting apparatus of infants is not complete at birth. The external meatus and the tympanic cavities are transformed after birth from cavities filled with cellular tissue to pneumatic cavities. It was formerly supposed that infants did not react to sound, but it has been proved that this is not the case, even with newborn infants, and infants can also perceive musical notes. Even in the second half of the first year of childhood it is, however, very difficult to decide whether the power of hearing exists or not. No great confidence can be attached to the statements of a child's friends as to its having heard certain sounds, as the vibrations of the air caused by certain sources of sound may produce effects upon the sensory nerve which may be mistaken for the result of vibrations of air acting upon the auditory nerve. It is, therefore, of the greatest importance, in experimenting with the hearing

of infants, to make use of such sources of sound, or to make use of them in such a manner, that only the vibrations of sound produced can be perceived. Loud dinner-bells are suitable for this purpose; the so-called watchman's whistle, Galton's whistle, clapping of hands, and the firing of small pistols, which the child should not be allowed to see. If the child reacts to these sounds it will blink its eyes or exhibit either joy or fear.

Should the results of such experiments be negative, it is not necessary, as before mentioned, to conclude that the child will become a deaf-mute. After the completion of the first year of infancy, however, the older the child, the greater the importance which must be attached to such negative results. After that period we may look for another symptom to help us in our diagnosis, viz.: the absence of speech. This, too, may be delusive, as some children, although in full possession of normal powers of hearing and intellect, do not begin to speak at the end of their first year, but later, sometimes much later. The cause may be some hidden condition or constitutional disease; for instance, rickets.

Another condition which may be mistaken for deaf-mutism is simple mutism (aphasia) uncomplicated with deafness or idiocy. This abnormality, which is not at all rare in adults as the result of certain brain diseases, is but seldom congenital or acquired in infancy, at least, there are but few references to it in literature. This form of aphasia must, according to some authors, be regarded as the result of a disease which is localized in the central nervous system, causing total inability of speech in the person affected, or inability to speak more than a few indistinct words. This infantile aphasia, which seems, as a rule, to be

congenital, differs from the mutism of deaf-mutism, principally inasmuch as it is not accompanied by deafness, and often, also, in the subject affected being able to produce certain words or sounds resembling words, which are always employed in attempts at speech. Aphasia accompanying feeble-mindedness, imbecility, or idiocy is a much more frequent abnormality, which is still more easily mistaken for deaf-mutism, especially in such cases where the imbecility is so considerable that the interest for sound is diminished. In these cases, however, the imbecility, which must be regarded as the primary disease, will generally show itself in the patient's appearance, movements, gestures, etc.

Hysterical mutism may sometimes simulate deaf-mutism. It is, however, generally accompanied by pronounced symptoms of hysteria, and exhibits itself by the patient's making no attempts to speak, or even to articulate. It is generally of short duration and easily recognized, the diagnosis only offering some difficulty in cases where the mutism appears in deaf, hysterical subjects.

The question whether deaf-mutism is congenital or acquired is, doubtless, that which offers the greatest difficulty in forming a diagnosis of deaf-mutism. In all cases, however, when the deafness appears after the child has begun to speak, or where the immediate causes of deafness are known, the diagnosis is an easy matter. If, on the contrary, the deafness has made its appearance prior to the period at which speech is generally developed—whether the morbid changes of the organs of hearing causing deafness are congenital or acquired—a decision as to the foetal or post-foetal origin of the deafness is accompanied by great, indeed often insurmountable, difficulties. In such cases it is, therefore, of the greatest

moment to obtain the most explicit information from the deaf-mute's friends, especially the parents, who are most likely to be able to give reliable information as to the diseases and pathological conditions which exist in the family. An opinion as to the origin of deaf-mutism can, as has been previously mentioned, only in exceptional cases be based upon objective examination of the subject. Such exceptional cases are, for instance, those in which visible and pronounced malformations of that part of the ear which is accessible to examination clearly indicate that deaf-mutism is the result of congenital changes of the auditory organs. Such cases are, however, very rare. Malformations in other parts of the body also indicate, though with a much less degree of certainty, that the condition in the ear is congenital; but these cases are rare. The objective examination of the ear, in the great majority of cases, offers nothing which can be relied upon with any degree of certainty, since, on the one hand, pathological changes of the external and middle ear, which may, according to their nature, be acquired after birth, may very well exist in persons whose deafness is due to congenital malformations of the auditory organ; while, on the other hand, less-pronounced congenital changes of the external and middle ear (for instance, lesser degrees of microtia and macrotia, contraction of the external meatus, abnormal position of the drum-head, etc.) may very well appear in persons with acquired deafness.

A final decision as to the congenital or acquired origin of a case of deaf-mutism must, then, in the majority of cases, be entirely based upon inquiry, and, even when explicit information is obtainable, it is often difficult to arrive at a definite opinion. It will be always advisable to

make inquiries whether the child's speech has developed in the same way as that of ordinary children of the same age, because non-professional persons' statements as to a child's power of hearing are often unreliable. Should the answers be in the affirmative, and should it be proved that the power of speech has been lost, or is arrested in its development from some or other cause (acute brain disease, scarlet fever, measles, etc.), it may be safely concluded that the deaf-mutism is of post-fœtal origin. This diagnosis is also justified, though with less certainty, when the above-mentioned causes have shown themselves during the first years of infancy, unless, of course, ample and satisfactory proof can be produced that the child has never possessed the power of hearing, or that the more remote causes of deaf-mutism (unfavorable social conditions, heredity, consanguinity, etc.) have appeared in great force; in such cases a decision must remain doubtful. Should, however, the possibility of the direct causes (scarlet fever, brain diseases, measles, etc.) be excluded, and it is proved that the child never possessed the power of speech, it may be supposed that the deaf-mutism is the result of congenital changes of the organs of hearing. This supposition is the more warranted the greater proof there is that the more remote causes of deaf-mutism have played their part in the case in question.

Etiology.—The causes of deaf-mutism may be subdivided into two groups: (A) the remote causes, and (B) the immediate causes.

(A) REMOTE CAUSES.—Among these are to be mentioned principally natural conditions, unfavorable social and hygienic conditions, heredity, consanguinity and a few others of minor importance.

Natural Conditions.—In considering

the unequal distribution of deaf-mutism, we are involuntarily led to the supposition that this phenomenon may be caused by varying natural conditions, among which soil and elevation seem to play an important part.

To H. Schmaltz is due the honor of having investigated the question of the importance of geological conditions and elevation in Saxony so thoroughly that his results are entirely to be relied on. In these investigations, which have embraced the minutest details which could possibly be of importance concerning the appearance of deaf-mutism, the author has weighed each separate point carefully. His conclusions are as follow: There is nothing to be said in favor of the hypothesis that soil, climate, or other territorial conditions influence the deaf-mute rate, neither can the composition of the water be proved to affect it in any way, but it is the social and hygienic conditions which are decisive. Lemcke, in Mecklenburg-Schwerin, and Uchermann, in Norway, were also unable to prove that geological conditions are a cause of deaf-mutism.

Unfavorable Social and Hygienic Conditions.—Almost all authors who have considered the question of the connection between deaf-mutism and unfavorable social and hygienic conditions, agree in ascribing to them great importance as causes of deaf-mutism. The statistical proofs in support of this hypothesis are not, however, on the whole, very satisfactory. The best statistics are furnished by H. Schmaltz, who has come to the following conclusions: "The industrial population, and especially that part of it which is worst off pecuniarily,—in fact, all who are in danger of degenerating both morally and physically on account of insufficient means, or poverty, and who consequently are unable or un-

willing to take the necessary care of their children,—all such persons exhibit the highest percentage of deaf-mutes among their descendants. Finally, when, in addition to all these unfavorable conditions under which children are born, they are brought up by a family which, from various reasons, is, perhaps, more or less degenerated, and have to undergo all sorts of diseases in infancy without having sufficient power of resistance, thus deaf-mutism is an only too common result." On the other hand, Uchermann states that in Norway unfavorable social and hygienic conditions are far from increasing the deaf-mute rate, it being higher among the better-situated classes.

Heredity.—Opinions have differed greatly as to the heredity of deaf-mutism, the reason being that not only are the laws which govern the hereditability of pathological changes and diseases subject to different interpretations, and that the statistics employed have given different results, but also that the term "heredity" is used in different ways.

The term "heredity" is used by many authors to express the frequent appearance of the same pathological condition in two consecutive generations, other influences having, of course, been excluded. The statistics which have been employed in attempts to solve the question of the frequency with which deaf-mutism appears in two consecutive generations have been based on two different methods: the one calculating how often deaf-and-dumb persons had deaf-and-dumb parents, the other how frequently unions where the one or both parties were deaf and dumb resulted in deaf-and-dumb offspring.

The first mode of ascertaining the frequency with which deaf-mutism appears in two generations, consisting in discovering how often deaf-and-dumb subjects

belonging to large groups of deaf-mutes are descended from deaf-and-dumb parents, everywhere gives the result that deaf-mutes very seldom have deaf-and-dumb parents. This is even the case when only congenitally deaf have been the objects of investigation, Uchermann, for instance, finding in Norway among 921 deaf-mutes with congenital deafness only 2 with deaf-and-dumb parents. This seems to prove that deaf-mutism is rarely inherited in the strictest significance of the term, or, as it might also be expressed, inherited directly. It must, however, be borne in mind that marriages contracted by deaf-mutes are, and especially have been, comparatively rare in Europe, and also that their fertility is smaller than that of other marriages; there can certainly be no doubt that the direct hereditability of deaf-mutism is certainly of much greater importance than might be supposed from the above-mentioned statistics.

This opinion is corroborated by statistics founded on the second mode of estimating the frequency with which deaf-mutism appears in two consecutive generations, viz.: by calculating how frequently unions where one or both parties are deaf and dumb result in deaf-mute offspring. The European statistics of this kind are but few and small, the reason being mentioned above, while the excellent American statistics collected by E. A. Fay are very comprehensive, marriages contracted by deaf-mutes being so much more frequent in the United States. The principal results of European statistics have been that a deaf-and-dumb child was born in about every thirtieth or thirty-first union where one party was deaf and dumb, and that deaf-mute offspring were much more frequently the result of unions where both parties were deaf and dumb. The sta-

tistics published by Fay are based on investigations of over 5000 marriages contracted by deaf-mutes and have given the result that over 9 per cent. of these resulted in "deaf offspring, and, curiously enough, the marriage where both parties were deaf did not result more frequently in deaf offspring than those where only the one party was deaf." Fay also found that marriages of congenital deaf persons and of deaf persons with deaf relatives gave a far greater liability to deaf offspring.

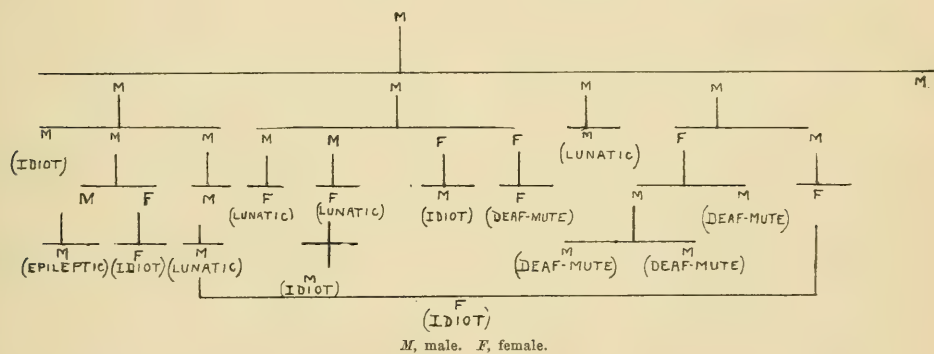
If, now, the term "heredity" is used to express the conspicuous frequency with which the same abnormality appears in the same family, the hereditability of deaf-mutism becomes still more evident. The frequency with which deaf-mutism appears among the parents of deaf-mutes has been mentioned above. Cases of deaf-mutism among the grandparents, great-grandparents, etc., of deaf-mutes, which should prove the direct heredity *per saltum*, as it is termed, must necessarily be still less frequent, as marriages between deaf-mutes were very rare in the first half of this century. If we, however, look for cases of deaf-mutism in other branches of the deaf-mutes' family-tree, we find in all statistics that—considering that deaf-mutism is a comparatively-rare pathological condition—a great number of deaf-mutes are to be found among the uncles, aunts, great-uncles, great-aunts, cousins, and second cousins of deaf-and-dumb persons. According to European statistics, embracing a large number of deaf-mutes, about every sixteenth deaf-mute has one deaf-and-dumb relative among the category above mentioned (parents, grandparents, brothers, and sisters excepted), the point where deaf-mutism most often appears corresponding to generations co-ordinate with the parents. These statistics have

also shown that it is almost exclusively congenital deafness which plays a part in this respect. Deaf-mutism, finally, is to be met with more frequently among the brothers and sisters of deaf-mutes, and there are statistics as to congenital deaf-mutes according to which 50 per cent. of these had one or more deaf-and-dumb brothers or sisters. The appearance of deaf-mutism in two or more children of the same parents is very characteristic, and there are few pathological conditions which show such a tendency to appear in the same branch of a family, there even being cases on record where ten deaf-and-dumb children were born in the same marriage.

frequency among the relatives of deaf-mutes and with about double the frequency among the relatives of congenital deaf-mutes as among the relatives of deaf-mutes with acquired deafness.

Their appearance is particularly clearly demonstrated by several genealogical tables published by Dahl and Ucher-
mann, of which the one depicted below is an interesting example.

[Albinism, retinitis pigmentosa, and malformations are also frequently found among the relatives of deaf-mutes; these anomalies are probably to be considered as signs of degeneration, deaf-mutism itself being undoubtedly in several cases a degenerative phenomenon. These anomalies, however, might also be con-



Finally, if by heredity we understand the frequent appearance in a family of not only one pathological condition, but of several others related to it anatomically or etiologically, we shall see that heredity is a most important factor in the etiology of deaf-mutism. It is, namely, proven by several comprehensive statistics that partial or total deafness due to different ear diseases (which have not led to deaf-mutism, on account of the lesser degree of the loss of hearing or of its unilateral appearance, or of its later development in life), insanity, epilepsy, idiocy, stammering, and other defects of speech, hysteria, and several other nervous diseases appear with conspicuous

sidered as "nervous abnormalities." HOLGER MYGIND.]

The laws which may, then, be supposed to regulate the heredity of deaf-mutism are difficult of interpretation, and seem in many respects to differ from those which relate to other pathological conditions and diseases. This may be accounted for by supposing that, as the causes of deaf-mutism in general are numerous and varied, so are also the causes of each individual case. The circumstance that deaf-mutism, so far as its etiology is concerned, must be divided into two distinct classes, the congenital and the acquired, the latter of necessity including numerous cases in which deaf-

ness is to be traced to accidental causes, is alone sufficient to render the interpretation of the laws of heredity, by the help of investigations which embrace deaf-mutes in general, of the greatest difficulty. When we add to this that, although the importance of heredity in deaf-mutism is undoubted and considerable, there are other factors of at least equal importance, and that there is much which tends to neutralize the transmission of morbid tendencies (favorable social conditions, crossed marriages, etc.), it will be evident that there is much which renders a just explanation of the laws of heredity anything but an easy task. If we compare deaf-mutism with hæmophilia, which it resembles so far as heredity is concerned, we shall see how correct the above statements are. Hæmophilia—which, like deaf-mutism, may pass over several generations and accumulate in a single, being also most frequent among males and in the children of fruitful marriages—is, etiologically, but little complicated, partly because it is not related to any other anomaly, and partly because heredity is the governing cause. With deaf-mutism it is very different. It, too, may accumulate in single generations, being most frequent in brothers and sisters and much less frequent in the older generations. In these, however, there can be found a comparatively large number of cases of partial or total deafness, insanity, epilepsy, etc., which seems to indicate that deaf-mutism is, in many cases, a combined result of the transmission of various influences. These influences fall into two groups: those which originate in ear diseases, and those which originate in nervous disease in the family. Now, as the morbid anatomy of deaf-mutism proves that in the majority of cases the deafness causing deaf-mutism arises from abnormali-

ties of the nervous parts of the auditory organ,—the labyrinth,—there is reason to suppose that in many cases deaf-mutism is caused by the transmission of the above dual influences through the parents. Supposing this hypothesis to be correct, our knowledge of the laws of heredity in deaf-mutism assumes at once a more distinct form, though we cannot ever expect it to be as clear as it is, for instance, in regard to the laws which govern hæmophilia, for, as above mentioned, the causes of deaf-mutism are too numerous and varied. Even twins, who would seem to be exposed to exactly the same influences during foetal life, are sometimes the one a deaf-mute, the other a normal subject.

Consanguinity.—The question of the importance of consanguinity as a cause of deaf-mutism has been a fruitful subject of discussion. The first decidedly-expressed opinion upon this topic appeared in 1846, when Ménière and Puy-bonnieux, who were, respectively, medical attendant and teacher at the State Deaf and Dumb Institution in Paris, laid great stress upon the important part which consanguinity played in deaf-mutism, without, however, producing statistics in support of their theory. Such, however, appeared shortly after in the returns of the Irish census of 1851, which was the first to include this question in its rubrics, and, from the results thus obtained, Wilde came to the conclusion that “among the predisposing causes of mutism the too-close consanguinity of parents may be looked upon as paramount.” Vulliet, Landes, Chazaraïn, Bemiss, Howe, Dahl, Boudin, Mitchell, and the undaunted defender of the doctrine of consanguinity, Devay, were all in favor of the importance of this factor in the etiology of deaf-mutism, while Bourgeois, Périer, Huth, Voisin,

and G. Darwin were more or less opposed to the hypothesis that consanguineous marriages predispose to degeneration in the offspring, deaf-mutism being generally the principal object of their arguments. Statistical information as to the frequency of consanguinity among the parents of deaf-mutes has also been forthcoming, the frequency with which deaf-mutes are reported as being born in consanguineous marriages varying from 1.6 to 9.4 per cent., while the percentage for deaf-mutes with congenital deafness varies from 2.8 to 23.0 per cent.

It will be seen, then, that statements as to the frequency with which deaf-mutes are born in consanguineous marriages differ considerably. This can most naturally be explained as resulting from various circumstances. To begin with, such marriages vary in frequency in different countries; thus, in Prussia they form only 0.8 per cent. of all marriages; in France 1 to 2 per cent.; and in England 3 per cent. at the outside; in Denmark 3 to 4 per cent., in Saxony 4, and in Norway over 6.65 per cent. Further, there is no doubt that the frequency of consanguineous marriages differs in the different confessions and classes of society, in cities, and in the country, and here, also, in different districts. It must also be observed that the various statistics sometimes embrace whole countries, sometimes single districts, and sometimes deaf-and-dumb institutions, clinics, etc. The information in question has also been obtained in different ways; for instance, by reports, censuses, individual investigations, etc., and finally the different authors have included different degrees of relationship.

Although many investigators have found comparatively few deaf-mutes born in consanguineous marriages, there are several circumstances which seem to

prove that consanguinity is an important factor in the etiology of deaf-mutism. They are the following:—

Several statistical reports, the reliability of which cannot be doubted, are to the effect that deaf-mutes are comparatively often born of consanguineous marriages, and there seems to be reason to lay greater stress upon such positive results than upon those pointing in a negative direction.

All authors are unanimous in declaring consanguineous origin to be more common among congenital deaf-mutes than among deaf-mutes in general. This indicates that it is deaf-mutes with acquired deafness who reduce the rate that expresses the frequency with which deaf-mutes in general are born in consanguineous marriages. That consanguinity plays a part in congenital deafness only, or almost only, may be seen from the circumstance that all authors who have occupied themselves with this subject have come to the result that deaf-mute children born of consanguineous marriages are, in the majority of cases, born deaf, while only a small majority become deaf after birth.

That consanguinity is of importance in the etiology of deaf-mutism is evident from the circumstance that several authors have proved that, among the marriages of which the deaf-mutes are born, the consanguineous unions produce a larger number of deaf-mutes than the crossed.

Finally, several statisticians have proved that, the closer the degree of relationship between the parents, the larger was the number of deaf-mute children born.

It will be seen that there are various circumstances which clearly indicate that the intermarriage of relatives plays no insignificant part in the etiology of deaf-

mutism. Everything, however, tends to prove that it is entirely, or principally, in congenital deafness that consanguinity is an important etiological factor.

It is, however, undecided whether consanguinity in itself is a remote cause of deaf-mutism, or whether it is through the intensified transmission of hereditary, morbid conditions or tendencies prevalent in a family that it makes itself felt. Theoretical considerations and a few lately published investigations in Norway by Uchermann are strongly in favor of the latter supposition; still it is but fair to say that up to the present there have not been many or convincing facts brought forward in its support.

There are, then, but few facts which serve to elucidate the question whether the influence of consanguinity upon deaf-mutism is direct or indirect. Further investigations of the same nature will, perhaps, throw more light upon this subject. The final solution of the question will, however, in all probability, only be brought about by means of information as to the family, supported by an exact knowledge of the relatives of the deaf-mutes, and supplemented by their thorough objective examination. It is only thus that it will be possible to find less pronounced, but not on that account less important, abnormalities in the family, and to discover with what frequency the influence of heredity can be, with certainty, excluded in consanguineous marriages resulting in deaf-mute children.

There are, besides the above mentioned, several other remote causes, which are, more or less properly, supposed to play a part in the etiology of deaf-mutism; of these the most important are the following:—

Alcoholism in the Parents.—Although the abuse of alcohol is extremely common, and although we have no informa-

tion as to its frequency, on the whole; still, several reports seem to indicate that alcoholism in the parents plays some part in the etiology of deaf-mutism. Among the most important facts as to this question must be mentioned those stated by Uchermann in Norway, where, in cases of deaf-mutism of non-hereditary origin, alcoholism was found with double frequency among the parents of the deaf-mutes with congenital deafness than among parents of deaf-mutes with acquired deafness. It is at present impossible to form any accurate opinion as to whether alcoholism makes itself felt by weakening the parents' constitution, or whether it is an expression of a nervous disposition.

Syphilis in the Parents.—This disease has, on the whole, been found comparatively seldom among the parents of deaf-mutes. This does not, however, prove that syphilis plays no part in the etiology of deaf-mutism, for it is often difficult to discover, by questioning, whether a person has, or has not had, this disease, and it is also possible that investigations have, up to the present, been deficient in this particular. It is, at all events, certain that syphilis in the parents may produce a form of deafness in the children, appearing in the later years of childhood, and often leading to deaf-mutism. This form of deafness will be mentioned more particularly under the special etiology of acquired deaf-mutism.

Age and Difference in Age of Parents.—Ménière was the first to draw attention to these two factors in the origin of deaf-mutism, stating that, according to his experience, deaf-mutes were often the children of young parents, and that such marriages were frequently sterile or resulted in weakly offsprings. Later investigations have, however, not confirmed this.

Fertility of Marriages.—All authors who have directed their attention to this subject agree that marriages producing deaf-mutes are remarkable for their fertility. According to Uchermann, this may be explained by supposing that, the greater number of children there are born, the more strongly the hereditary disposition to deaf-mutism, hæmophilia, etc., shows itself.

(B) IMMEDIATE CAUSES.—According to recent statistics, in about one-half of the cases of acquired deaf-mutism the deafness is acquired during the first three years of infancy, the greater number of cases falling in the third (statistics from the United States) or the second (European statistics) year of life; then comes the fourth, the first, the fifth, sixth, and so on.

Brain Diseases.—These play an important part in deafness acquired after birth and resulting in deaf-mutism. The Irish statistics of 1881 show the lowest figure, viz.: 11.9 per cent.; and the Pomeranian report the highest, viz.: 54.5 per cent. It will be seen that the importance of brain diseases in the etiology of deaf-mutism varies considerably in the different countries; this is not only due to the circumstance that the expression "brain disease" includes different affections in the different reports, but also to the varying intensity with which cerebral disease appears at different times and at different places. All modern investigators agree, however, that brain diseases are at present the predominant cause of acquired deaf-mutism.

There can be no doubt that the most frequent brain disease leading to deaf-mutism is *epidemic cerebrospinal meningitis*, the deleterious influence of which has been especially pointed out by Moos. We possess various clinical observations of partial or complete deafness caused by

epidemic cerebrospinal meningitis, and post-mortem examinations of persons whose deafness is due to this disease or other similar brain diseases, which elucidate the manner in which cerebral affections act deleteriously upon the infantile organs of hearing. The great conformity which exists between the changes in the auditory organs caused by cerebrospinal meningitis and changes declared to be due to inflammation of the brain in general, or to other diseases with pronounced cerebral symptoms, authorizes us to suppose that the facts related in the following paragraphs hold good for the majority of cases of deaf-mutism caused by acute brain disease.

Clinical experience teaches us that the very considerable defects in hearing which appear during epidemic cerebrospinal meningitis may have a dual origin, viz.: inflammation of the middle ear or an affection of the labyrinth. Loss of hearing from the former cause is, however, seldom so considerable or so lasting as to result in deaf-mutism. Deafness resulting from labyrinthine disease is more rare, but, at the same time, of more importance, since the loss of hearing is, as a rule, very considerable, often, indeed, total, generally affecting both sides, and nearly always permanent. According to Moos and Knapp, labyrinthine deafness in epidemic cerebrospinal meningitis generally appears suddenly, seldom gradually. As a rule, it appears in the course of the first two weeks, but may also show itself later; Knapp reports a case where it appeared even six weeks after the commencement of the disease.

Acute Infectious Diseases.—The importance of this group of diseases in the etiology of deaf-mutism is doubtless at present less marked than that of brain diseases. If, however, epidemic cerebro-meningitis is included among acute in-

fectious diseases,—to which group it doubtless belongs,—they immediately assume a very prominent place, and there can be no hesitation in declaring that the great majority of cases of deaf-mutism caused by acquired deafness are the result of acute infectious diseases. The importance of the parts played by the different diseases varies greatly, as will be seen, scarlet fever predominating.

Scarlet fever (*scarlatina*). This disease has always and in all countries been recognized as a very frequent cause of infantile deafness, and, consequently, of deaf-mutism. The influence of scarlet fever on deaf-mutism differs, however, in different countries and at different times, which is doubtless due to the varying intensity and character with which the disease appears. The lowest figures are represented by statistics from Italy (1.5 per cent.), the highest from Saxony (47.6 per cent.).

The origin of deafness in scarlet fever has been elucidated by clinical research, which proves that ear diseases caused by scarlet fever generally consist of inflammation of the middle ear, with a marked tendency to destroy the mucous membrane and osseous walls of the tympanum, and also the auditory ossicles. The inflammations of the middle ear, which are most frequently propagated through the Eustachian tubes, but which may, perhaps, appear independently, are not, as a rule, in themselves capable of causing a diminution of hearing in infancy so lasting and so considerable as to result in deaf-mutism, unless the labyrinth is affected. Scarlatinal deafness resulting in deaf-mutism is then, doubtless in most cases, due to a partial or entire destruction of the membranous contents of the labyrinth. This destruction is, in many cases, caused by the propagation of the inflammation to the internal ear either

through the fenestræ (*fenestræ rotundis et ovalis*) or through the vessels leading from the tympanum to the labyrinth. Some post-mortem examinations of deaf-mutes, whose deafness was the result of scarlet fever, support the former theory, indications of an inflammation of the middle ear being found, also abnormalities in one or both fenestræ, doubtless the result of an inflammatory process. On the other hand, there are various circumstances which indicate that scarlatinal affections of the labyrinth may appear independently of an inflammation of the middle ear, or that, if such inflammation had existed, it has been very slight. Thus, for instance, it is often found, on otoscopic examination of deaf-mutes, who have become deaf after scarlet fever, that the drum-head exhibits but slight or no abnormalities.

Measles (*morbilli*). The reports relating to the frequency of measles as a cause of deaf-mutism vary greatly, though not so much as was the case with scarlet fever, which disease also assumes a much more prominent rank in the etiology of deaf-mutism; the lowest rate is Wurtemberg and Baden (1.0 per cent.), the highest Mecklenburg-Schwerin (8.3 per cent.).

Among other infectious diseases which now and then cause deaf-mutism may be mentioned the different varieties of typhus (typhoid fever, exanthematic typhus), diphtheria, small-pox, chicken-pox, erysipelas, dysentery, influenza, ague, whooping-cough, mumps, inflammation of the lungs, and rheumatic fever.

Constitutional Diseases.—Of these may be mentioned rickets, scrofula and syphilis. Although syphilis is represented in most statistics relating to the causes of deaf-mutism by only a fraction or not at all in modern statistics, there can be

no doubt that when inherited from the parents it plays some part in deafness acquired in infancy and resulting in deaf-mutism. Inherited syphilis may, as is well known, produce a peculiar form of deafness accompanied by certain ocular affections, which, it is true, generally appears after the age of puberty, but which, however, also shows itself before that period, even as early as the age of four. The circumstance, however, that hereditary syphilitic deafness often appears without any other marked symptoms of syphilis, and that it is extremely difficult to discover syphilis in the parents, especially by questions alone, explain why this disease is so seldom noticed in the parents of deaf-mutes in hitherto-published statistics. It seems, also, that acquired syphilis may cause deaf-mutism; but no investigators have, up to the present, touched upon this subject.

Injury (Trauma).—Although it is probable that traumatic influences, such as falls, blows on the head, etc., to which children are especially subject, are sometimes stated as being the cause of deaf-mutism in cases of really congenital origin, there is no doubt that such causes may produce deafness resulting in mutism, as ear diseases of traumatic origin are not at all unknown, even among adults. Injury also is included in the causes of deaf-mutism in nearly all the more considerable statistics, the figures, however, being but small.

Morbidity Anatomy.—Although a partial examination of the auditory organs of deaf-mutes during life-time is possible, still it can only embrace the peripheral parts, and there must always be a difficulty in deciding whether the morbid changes thus revealed are of primary or secondary importance, or, indeed, only accidental. It is, therefore, only possible

to arrive at an intimate knowledge of the morbid changes causing deaf-mutism and hence, at the just comprehension of its nature, by means of post-mortem examination. We have but few reports of such examinations dating earlier than the commencement of this century, and they yield so little information that we can only surmise that the examinations have been incomplete.

Before discussing the different parts of the auditory organs in which morbid changes have been found, it must be observed that several investigators have found no changes whatever in some of the cases examined by them; indeed, Ibsen's and Mackeprang's investigations gave negative results in no less than one-third of all their cases. As, however, these investigations date from a period when the microscopical examination of the labyrinth was but little developed, and as no mention is made of an examination of the brain or of the auditory nerve, the negative results arrived at lose considerably in importance, for it is possible that the parts of the auditory organ above mentioned have been the seat of undetected abnormalities.

Morbidity Changes of the Middle Ear.—If we take a survey of the pathological changes of the middle ear which have been found in post-mortem examination of deaf-mutes, we shall find that such changes are remarkably frequent. It is only exceptionally that these have been the result of malformation; they have, in the majority of cases, owed their presence to inflammatory processes or the remains of such. These inflammatory processes have sometimes been of catarrhal nature, but generally suppurative, in which cases they have been intense and destructive. The abnormalities which are characteristic of the morbid anatomy of deaf-mutism have had

their seat about the two fenestræ, especially in and around the fenestra rotunda, which has exhibited anomalies in not less than one-fourth of all the dissections which yielded positive results, and has in particular been frequently closed by osseous masses. In the majority of cases, however, the abnormalities of the middle ear have been accompanied by marked changes of the inner ear.

Morbid Changes of the Labyrinth.—These have affected either the whole labyrinth or only parts of it. The so-called entire absence of the labyrinth plays an important part among the former class, partly on account of its comparative frequency, and partly on account of its origin. The majority of authors have hitherto regarded the absence of the labyrinth as the result of arrested development. I have, however, in several of my works proved that partial or complete absence of the labyrinth, or of parts of it, may be, and probably most frequently is, caused by the deposit of osseous tissue in the labyrinthine cavity, which becomes thus more or less completely filled up, under which process the normal outlines may disappear entirely. Such a formation of osseous tissue is without doubt the result of a previous inflammatory process; that is, of an *otitis intima*. I have also pointed out that it is impossible to distinguish between foetal and post-foetal morbid changes by post-mortem examination, unless accompanied by exhaustive and reliable information as to the cause and date of the affection. From the following it will be evident that the deposit of osseous tissue in the cavity of the labyrinth is one of the most frequent labyrinthine anomalies found upon post-mortem examination of deaf-mutes, the osseous mass sometimes filling the whole

cavity, while sometimes only a section exhibits a parietal deposit which has merely caused a diminution of the cavity in question. The most extensive formations of osseous tissue in the labyrinth are apparently the result of a post-natal *otitis intima*. It is interesting to observe that various investigators have discovered such osseous deposit sometimes on the one side only, sometimes on both, some having also found osseous tissue on the one side, and deposits of chalk or fibrous tissue—which may also, as is well known, be the result of inflammatory processes—on the other side, while both the latter deposits have also been frequently found in the labyrinths of deaf-mutes when there was no formation of osseous tissue on either side. Inflammatory and also degenerative processes may leave other products behind them, which may appear in like manner in other parts of the body. I would not, however, imply that the partial or total absence of the labyrinth may not be the result of arrested development, which, on the other hand, may be due to foetal inflammatory processes. Still, it is often difficult to find proofs that such has been the origin of the abnormalities in individual cases. A case observed by Michel is, however, of this nature, as the petrous bone was entirely deformed, and it seems as if we might be justified in expecting important malformations of the labyrinth to be reflected in the shape and appearance of the petrous bone. In many cases the inflammatory process in the labyrinth causing its partial or complete destruction was secondary to an inflammation of the middle ear. According to the reports of several post-mortem examinations, the inflammation of the middle ear was due to acute infectious diseases, in particular scarlet fever and measles. In conformity with the above,

it will be seen that in dissections, in which the complete or partial absence of the labyrinth was discovered, tolerably well-marked changes were found in the middle ear, consisting, in great part, in the remains of inflammatory processes; and this was true of many of the cases which will be mentioned further on as examples of circumscribed deposit of osseous substance in the labyrinth. On the other hand, the absence of inflammatory processes in the middle ear, or the traces of such, and in other cases the histories of the cases seem to indicate that the labyrinthine inflammation is not of necessity propagated from the middle ear, but that it frequently originates in the membranes of the brain. This is especially probable in all cases where meningitis is with certainty stated to be the cause of deafness. There is, perhaps, a third kind of labyrinthine inflammation,—viz., primary inflammation,—which has been especially defended by Voltolini and called after him *otitis intima* of Voltolini. The existence of this affection cannot be proved or disproved by arguments drawn from the material here under discussion.

As far as the seat of the labyrinthine changes in deaf-mutes is concerned, the vestibule (with the exception of its aqueduct) is the part of the labyrinth which has been least frequently found to be the seat of morbid changes. The reason is that the vestibule is, comparatively speaking, seldom found to be abnormally changed on post-mortem examination of deaf-born deaf-mutes, anomalies in the two other principal sections of the labyrinth being twice as frequent in these cases. It is also remarkable that in no hitherto-published post-mortem examination of a deaf-mute with acquired or congenital deafness, or where the origin of the deafness is not

stated, has the vestibule been the only section of the labyrinth which has been the seat of abnormalities, the other sections being also changed when this has been the case with the vestibule.

The semicircular canals are decidedly the portion of the labyrinth which is most frequently the seat of pathological changes; these are, indeed, so frequent here, that more than one-half of the dissections have yielded positive results. Indubitable cases of congenital malformations have been observed by several investigators, but it is questionable whether such abnormalities as the union of the two canals into one, shortening or lengthening of the canals, etc., are to be regarded as of vital importance. In not less than one-fifth of all the dissections yielding positive result the semicircular canals were the only part of the labyrinth which exhibited morbid changes. In the majority of cases in which the semicircular canals have been the seat of abnormalities they, or a part of them, have been filled up by osseous tissues, or must have been supposed to have been so; for instance, in the many cases where the reports simply mention "absence" of these canals. The posterior canal has been most frequently attacked, either above or together with the superior, but principally together with both the superior and the external. There is no reason to presume the frequent occurrence of abnormalities of the semicircular canals to be a frequent cause of deaf-mutism, but only a conspicuous proof of the frequency with which labyrinthine inflammations are a cause of that anomaly. The abnormalities discovered in the semicircular canals point also in another direction when it is remembered that it is an approved fact that disturbances of the equilibrium are very common among deaf-mutes. In this

respect post-mortem clinical observations of deaf-mutes speak strongly in favor of the theory of the influence of the semicircular canals on the equilibrium of the body: a theory which has lately found much support in Ewald's work.

Morbid changes of the cochlea are somewhat more frequent than those of the vestibule, and are very equally divided between congenital and acquired cases of deaf-mutism. In several cases the cochlea was the only part of the labyrinth which was the seat of morbid changes; in the great majority of cases, however, other parts of the inner ear have been abnormal, the semicircular canals having been at the same time especially frequently the seat of anomalies. The more or less entire filling up by osseous or calcareous masses is the anomaly most common to the cochlea, and under this heading may doubtless be included all cases in which the cochlea is reported to be entirely absent, or in which only one or two cavities remained. Abnormalities of this nature are mentioned in about one-eighth of all hitherto-published post-mortem examinations.

Morbid Changes of the Auditory Nerve.

—It is a fact that, although atrophy and degeneration of the auditory nerve, or a part of it, are frequent in deaf-mutes, they are far from being always present, as believed by many, since Hyrtl put forward that supposition, based upon

post-mortem examinations performed by him. As it is to be supposed that the auditory nerve of the majority of deaf-mutes examined post-mortem has been out of function some time, without there being found any atrophy or degeneration in it or its branches, it would seem that this nerve is not particularly disposed to become atrophied or degenerated from inactivity. The correctness of this hypothesis is confirmed by morbid anatomical examinations hitherto published of persons who have become deaf at a more advanced age, which examinations all point in the same direction. The cases of atrophy or degeneration of the auditory nerve which have been found by post-mortem examinations of deaf-mutes, seem, therefore, as a rule, to be due to some other cause, and we are obliged to regard them as the result of either centripetal atrophy or degeneration subsequent to labyrinthine destructive processes, or as the expression of a centrifugal change arising from primary disease of the central nervous system.

It is impossible as yet to give any satisfactory reason why the auditory nerve in some deaf-mutes is atrophied or degenerated while in others it is not. The question will doubtless be cleared up by a larger number of post-mortem examinations of deaf-mutes, accompanied by reliable information as to the origin of the deafness.

Examination of 415 young deaf-mutes, in regard to primary cause and to the condition of the ears, the nasal chambers, and organs of phonation. A. A. Bliss (Med. News, Nov. 19, '92).

CONDITION OF THE EARS.

	Group 1.	Group 2.	Group 3.	Total.
Plastic otitis media.....	75	20	16	111
Adherent and immovable drum-heads..	94	28	3	125
Very feebly movable drum-heads.....	43	12	4	59
Atrophic drum-heads.....	2	0	0	2
Engorgement of manubrial vessels and pinkish tint of drum-head.....	6	3	1	10

CONDITION OF THE EARS (*continued*).

	Group 1.	Group 2.	Group 3.	Total.
Calcareous deposits in drum-head.....	14	2	0	16
Double perforations with otorrhœa.....	9	5	3	17
Single perforations with otorrhœa.....	10	5	1	16
Cicatrized perforations, many of them covered with new membrane.....	32	13	3	48
Double impactions of cerumen.....	14	5	0	19
Single impactions of cerumen.....	15	7	2	24
Atresia of external auditory meatus....	2	0	0	2
Undeveloped auricles with absence of auditory meatus.....	1	0	0	1
Foreign bodies.....	6	0	0	6
Desquamative otitis externa.....	4	0	0	4
A slight trace of hearing.....	6	17	2	25
Hearing on contact only.....	62	6	10	78
Fair hearing.....	0	2	0	2

PRIMARY CAUSE.

	Cases.		Cases.
Spotted fever.....	43	Cholera infantum.....	1
Scarlet fever.....	66	Shock	1
Measles	17	Mumps	1
Meningitis	29	Bronchitis	1
Typhoid fever.....	5	Catarrhal fever.....	1
Pneumonia	2	Sun-stroke	1
Diphtheria	2	Otitis media.....	9
Malaria	2	Whooping-cough	2
Small-pox	1	Teething	3
"Colds"	13	Croup	1
Convulsions	10	Eczema	1
Black fever.....	3	Unknown (exclusive of 137 pupils credited as being deaf-mutes from birth)	49
Traumatism	9		
Spinal meningitis.....	5		
Inflammation of bowels.....	2		

PATHOLOGICAL CONDITIONS PRESENT.

<i>Nares.</i>	Group 1.	Group 2.	Group 3.	Total.
Deformities consisting of deviated septa, exostoses, hypertrophied turbinals, causing partial or complete occlusion of one or both nares.....	65	14	4	83
Posterior hypertrophies of turbinals....	21	1	2	24
Impactions of middle turbinals against the septum.....	14	3	0	17
Synechial bands between the septum and lower turbinals.....	2	2	0	4
Sclerosis of mucous membrane in the anterior nares.....	35	7	5	47
Sclerosis in posterior nares.....	13	8	0	21
Atrophy of nasal mucous membrane....	20	2	0	22
General catarrhal condition due to vaso-motor paresis without deformities....	13	3	0	16

PATHOLOGICAL CONDITIONS PRESENT (*continued*).

	Group 1.	Group 2.	Group 3.	Total.
Adenoids in vault of pharynx, causing partial occlusion of this space or pressure upon the Eustachian openings....	57	14	8 ²	79
<i>Tongue.</i>				
Abnormally-short frænum.....	24	0	1	25
Hypertrophy of the lingual tonsil worthy of note.....	12 ¹	1	0	13
<i>Palate.</i>				
Abnormally high, narrow, and Gothic-arched	8	0	2	10
Deflection of raphé from median line, most frequently to the left side.....	6	0	0	6
Double uvula.....	2	0	0	2
Relaxed and pendulous soft palate.....	2	0	0	2
<i>Tonsils.</i>				
Large tonsils filling the spaces between the faucial pillars of their own sides of the throat, but not adherent to these bands, or not causing serious occlusion or pressure upon surrounding parts.....	32	16	1	49
Tonsils greatly hypertrophied, diseased, and causing pressure upon the palate or tongue, and greatly occluding the faucial space.....	18	5	4	27
Adhesion between tonsil and faucial pillars, the tonsil being encapsulated....	30	6	5	41
Narrowing of fauces by broad posterior pillars with high attachment to the pharyngeal walls.....	11	0	0	11
<i>Pharynx.</i>				
Simple hypertrophy of mucous follicles..	23	3	2	28
Sclerosis of mucous membrane with follicular hypertrophy.....	9	6	0	15
Simple sclerosis of mucous membrane..	55	20	5	80
Atrophy of mucous membrane.....	8	1	1	10
Venous engorgement worthy of note...	22	2	3	27
<i>Larynx.</i>				
Epiglottis abnormally depressed.....	14 ³	2	0	16
"Infantile" epiglottis.....	2 ⁴	0	0	2
<i>Vocal Bands.</i>				
Apparently normal in color and ordinary movement	83	63	12	158

¹ Six of these were in pupils between 14 and 22 years old; the other six in pupils under 14 years of age.² These eight cases all occurred in subjects between 12 and 19 years old.³ Only four being in pupils under 14 years of age.⁴ Both being in pupils over 14 years of age.

Examination of 175 deaf-and-dumb children. Tested by a large bell, a large tuning-fork, and the human voice. The children were found to divide themselves into:—

1. Those stone-deaf or having no aërial hearing,	9
2. Those hearing very loud sounds,—shouting, etc.,	81
3. Those hearing and distinguishing the voice:—	
(a) Vowels only,	20
(b) Consonants and words,	13
	33
	123
Disqualified for testing because of	
youth, idiocy, etc.,	49
Dumb, but hearing perfectly,	3
	175

Of the 9 totally deaf, by far the larger number were cases of congenital deafness. Of those who could hear and distinguish the voice, much the larger number were cases of acquired deafness. The causes of acquired deafness were found to be, in half the cases, primary disease or injury in the brain or internal ear, without apparent disease of the middle or external ear. Measles and scarlet fever were found responsible for 13 cases. Sixty-one cases of normal membrane were found among the 175 children; 32 showed suppurative disease, and nearly 80 catarrhal changes. The pharynx was diseased in most of the cases. J. K. Love (Glasgow Med. Jour., June, '93).

Post-mortem examination of the ears of a deaf-mute. The case was that of a young man, aged 18 years, who died from pulmonary and intestinal tuberculosis. When 2½ years old he suffered from scarlatina, and, as a result, became a deaf-mute. In the right ear the pathological conditions were confined to the labyrinth, and consisted of destruction of its integral parts, the various spaces having undergone ossification. The drum-head and tympanum were quite normal. The ligamentum annulare stapedis and the membrana fenestræ rotundæ were ossified; but this process was confined to the sides adjoining the inner ear. In the left ear were found otorrhœa, ossification of the spongy portion of the pars petrosa and of the processus mastoideum, and ossification of the

membrana fenestræ rotundæ; the ligament of the stapedius muscle was mov-

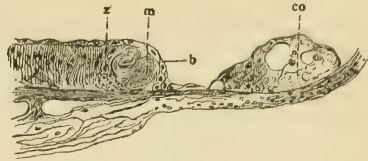


Fig. 1.

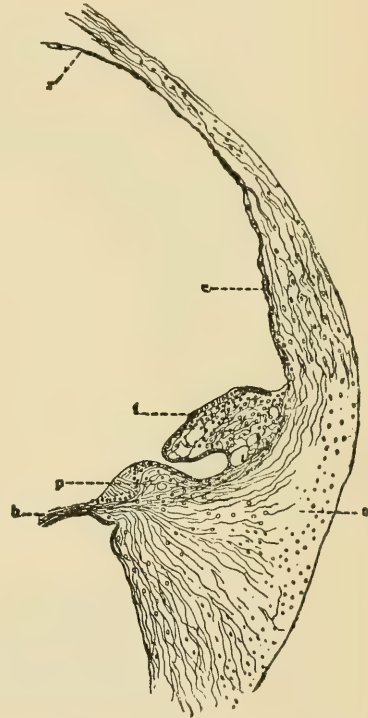


Fig. 2.

Auditory atrophy and anomalies of development in the membranous labyrinth of both ears in a case of deaf-mutism. (Scheibe.)

Fig. 1.—*co*, Corti's organ; *z*, increased cells in the sulcus spiralis; *b*, arched layer of cells, extending to the limbus laminæ spiralis osseæ; *m*, Corti's membrane.

Fig. 2.—*s*, Stratum semilunare; *b*, beginning of basilar membrane; *p*, prominentia spiralis; *l*, ridge on the stria vascularis; *e*, flat cells on the rest of the stria; *r*, a piece of Reissner's membrane, bulged forward toward the scala vestibuli; inserted somewhat peripherally, and extending, farther on, in a thicker layer of cells.

(Zeitschrift für Ohrenheilkunde.)

able. The inner ear showed no sign of pathological fluid or new formations. The surface of the brain showed no ab-

normality. Broca's convolution appeared smaller than normal. The superior temporal convolution of the left side was also smaller than usual. The microscopical examination did not show any positive signs of abnormality. These cerebral changes are supposed to result from atrophy consequent upon the inactivity of the parts, it being worthy of note that this left-sided atrophy is asso-

ness (field of vision) with the instrument of Landolt. Conclusions: The reactions to general sensitiveness and to pain, in the deaf-mute, are very little inferior to the normal. In early life, indeed, there is no difference worthy of note. So also with regard in general to the field of vision; it is normal both in extent and form, except for a readiness to fatigue, which by itself is anything but a serious

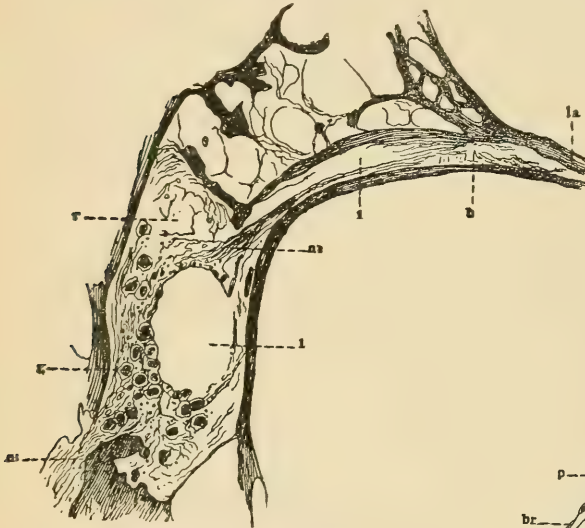


Fig. 3.

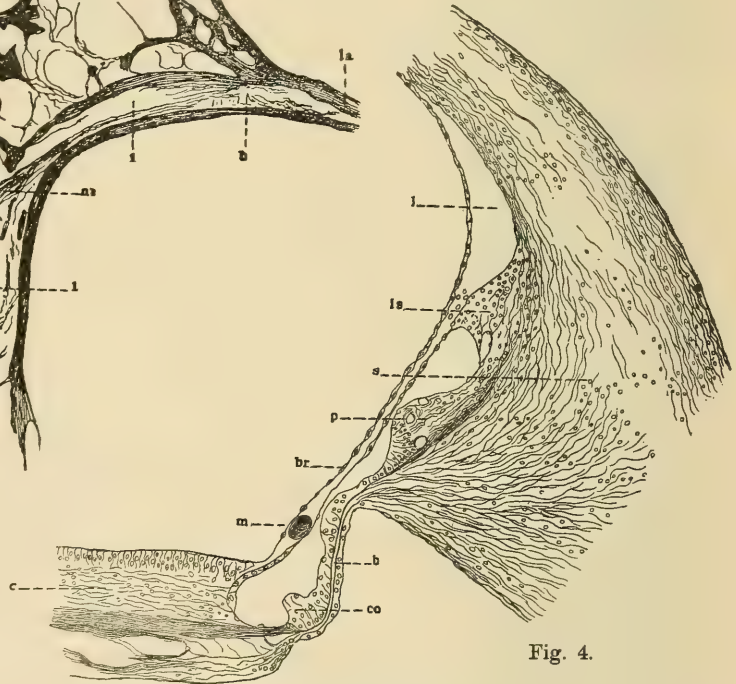


Fig. 4.

Auditory atrophy and anomalies of development in the membranous labyrinth of both ears in a case of deaf-mutism. (*Scheibe*.)

Fig. 3.—*r*, Rosenthal's canal; *la*, lamina spiralis ossea; *g*, ganglion-cells; *l*, lacuna; *nl*, entering nerve-fibres; *nl*, departing nerve-fibres; *b*, connective tissue.

Fig. 4.—*s*, Semilunar stratum; *c*, crista spiralis; *b*, basilar membrane; *co*, Corti's organ badly preserved; *p*, prominentia spiralis; *br*, bridge; *l*, lacuna in the stria vascularis; *ls*, ridge with attachment to the lower part of the bridge; *m*, rudimentary Corti membrane.

(*Zeitschrift für Ohrenheilkunde*.)

ciated with destruction of the right labyrinth. Conclusion that there is good ground for the belief that the fibres of the acoustic nerve cross in the brain. V. Uchermann (Annual, '93).

Examination of the reactions for general and painful sensations in forty-four deaf-mutes with the faradimeter of Edelman, and of the retinal sensitive-

sign of marked degeneration. The sensitiveness of the deaf-mute evidently expresses a mental development of a very satisfactory quality, and clearly differentiates him from such classes as the criminals, the epileptics, and the feeble-minded (partial imbeciles), not to mention more marked forms of degeneration. In spite of the absence of one sense, the

sensitive zone of the deaf-mute is not deficient. Various stimuli from all the sources in the sensorium reach his cortex, and this is in such condition as to be able to normally elaborate the stimuli; hence comes ease of perception and attention. All the other sensorial sources, if exercised, can supply the want of a source so full of ideas as is that of hearing, when the centre is normal. This fact should help our judgment in forming the scientific diagnosis of the deaf-mute. Deaf-mutism, by itself, does not mean serious degeneration. S. Ottolenghi (Jour. of Laryn., Jan., '96).

Case in which there were atrophic changes in the fibres of the cochlear branch occupying the first whorl, the corresponding portion of Corti's organ being reduced to a mere trace, while in the upper whorls it was lower than normal, the membrane being rolled up in the rudimentary way. This and other allied conditions indicated a congenital defect or arrest of development. A. Scheibe (Arch. of Otol., vol. xxiv, Nos. 3 and 4, '97).

Deaf-mutism is the result of aural disease acquired in infancy consecutive to acute rhinitis. From neglect there follows atrophy of the acoustic nerves. These cases would be curable if the nerves could be stimulated to proper development by vibrations carried through the cranial vault. Twelve deaf-mutes thus cured, but it required several years. The naso-pharynx received particular attention; the drum was mobilized by means of Politzer's inflator and by the apparatus of Delstanche, the patients also receiving oral instructions. Acute rhinitis in children should be carefully watched and treated. Verdos (Annales des Mal. de l'Oreille du Larynx, No. 5, '97).

Unchermann found in 1885 about 1841 deaf-mutes in Norway, of whom 51 per cent. were hereditary, and the remaining percentage were acquired, with the exception of 0.5 per cent., in whom it could not be determined. It is not always possible to determine, even by examination after death. Most cases of acquired deaf-mutism are caused by diseases of the labyrinth, most of which

have spread from the brain or middle ear. Mygind, in his work in 1894, reported over 139 cases in which the middle ear only was diseased, but he stated nothing about the labyrinth or the histological examination of the labyrinth. Thus, Matte could completely deny the occurrence of deaf-mutism due solely to middle-ear disease. Two personal cases in which the middle ear only was demonstrable as a cause of the deaf-mutism. J. Habermann (Archiv f. Ohrenh., Bd. liii, S. 52-67, 1901).

Morbid Changes of the Brain (Cerebrum).—The defective development of the surface of the third convolution and of the insula Reilii of the left side may be mentioned as an abnormality several times discovered in deaf-mutes, but which has no causal relation to deafness. Rüdinger and Waldschmidt found this abnormality in several deaf-mutes who presented no history of disease, and whose labyrinths were not examined, while other investigators found it in two deaf-mutes who had both become deaf after birth, in the third year, after meningitis and scarlet fever, respectively, and who both exhibited pronounced abnormalities in the ear. The flattening of the cerebral convolutions is doubtless due to atrophy, caused by the inactivity of the parts of the brain which are known to be the motor centre of speech, on account of the inactivity of the muscles of speech. In the two latter cases, also, there was information proving that the deaf-mutes in question had never learned to speak.

Case of deaf-mutism, in an adult, found at the autopsy to have been due to symmetrical lesions in the two temporal lobes. The entire cranial capacity was less than normal, the brain weighing 935 grammes (30 ounces), and the left hemisphere was almost one-fourth smaller by weight than the right. The first and second temporal convolutions were destroyed, normal being replaced by cicatricial tissue, while the third convo-

lutions—the supramarginal and the angular gyri—were atrophied and sclerosed. The convolutions of the island of Reil were intact on the right, but largely destroyed on the left; acoustic nerves very thin. The patient presented notable deficiency of intellect, with absolute deafness and dumbness. She possessed a certain amount of intelligence, however, and could comprehend, to a certain degree, mimetic language. No motor paralysis of trunk or limbs existed, nor was there any defect present in vision or cutaneous sensibility. Seppilli (*Alienist and Neurologist*, Apr., '93).

If we cast a retrospective glance over the foregoing facts it will be seen, first, with regard to the nature of the morbid changes met with in the hearing organs of deaf-mutes, that they do not differ, so far as their quality is concerned, from those generally found in ear diseases, but that the difference must be rather sought in the intensity and extent of the morbid processes. The abnormalities found in deaf-mutes may, at least in a great number of cases, be most naturally interpreted as being the results of intense and wide-spread inflammatory processes. This is particularly evident in cases referring to deaf-mutes who had become deaf after birth. It will further be seen that the abnormalities found in cases of congenital and acquired deafness often present exactly the same appearance; so that in many cases it is impossible to decide, from the post-mortem examination alone, whether the changes are of foetal or post-foetal origin. It is, thus, evident that the formerly accepted opinion, that deaf-mutism arising from congenital deafness was due to congenital malformations of the auditory organs, has not been confirmed, since abnormalities which are the indubitable expression of such malformations are but seldom met with. So far as the seat of the abnormalities was concerned, it was found that

these were, as a rule, bilateral, but have often differed greatly on either side, both as to character and localization, and especially as to intensity. The few cases in which the principal abnormalities were confined to the one side, while the other was normal or only the seat of unimportant anomalies, must, for the present at least, be looked upon with suspicion. Finally, it has been proved that the middle ear has very frequently been the seat of changes, accompanied, as a rule, by important abnormalities in the inner ear. These were most frequently situated in the semicircular canals, least frequently in the vestibulum, and were to be considered as the principal cause of deafness. The auditory nerve in many cases exhibited signs of atrophy and degeneration and a few other abnormalities, while in a considerable number of cases no changes were visible. In some few cases the brain deviated somewhat from the normal.

Deaf-mutism is, therefore, from an anatomical point of view, in most cases to be considered as a result of an abnormality of the labyrinth.

Prognosis.—There is no doubt that the prognosis of the deafness which is the cause of deaf-mutism is highly unfavorable, still there exist some well-authenticated cases of deaf-mutes whose power of hearing has been at least partially restored.

Treatment.—It is as yet difficult to say in what cases treatment is indicated, as we have not reached further than to the first experiments in that direction. I have latterly endeavored to act according to the following rules when deaf-mutes have been brought to me for treatment: Treatment is most decidedly indicated when the deaf-mute suffers from suppurative inflammatory processes of the middle ear. Treatment can, at

least in such cases, remove or diminish the danger which always attaches to sup-puration of the middle ear. Uchermann's experience also proves that the defects in the power of hearing may be diminished in cases of this nature. Treatment is also, I think, indicated in cases in which there are some traces of the power of hearing, and especially when this power exists with varying intensity, and where there are also symptoms of catarrhal conditions in the middle ear (catarrhal changes of the membrana tympani, retraction of the manubrium of the malleus, occlusion of the tubæ, etc.); also catarrh of the mucous membranes adjacent to the ear, especially when there also exist hypertrophy of the adenoid tissue in the naso-pharyngeal cavity. If the cranio-tympanic conduction still exists, the chances in this group of cases seem more favorable still. In cases of catarrh of the middle ear and adjacent mucous membranes, where no signs of hearing can be discovered after repeated examination, I have also attempted treatment; though I am not certain that such a course gives any hopes, as my experience has not been very favorable in this group of cases.

Useful hearing obtained in a deaf-mute aged 19 years. On examining the naso-pharynx a dense band of hypertrophy in each Rosenmüller fossa was found. The hypertrophied tissue was removed, and her ears were regularly politized. This was followed by a very great improvement in hearing, so that words distinctly spoken at the distance of a few feet in the ordinary voice could be understood. Gibson (*Australasian Med. Gaz.*, Oct., 1900).

To all the above-mentioned groups the indications are the same, whether the deafness is congenital or acquired. Various circumstances, which have been pointed out in the foregoing pages, indicate that total deafness resulting from

acute infectious diseases, especially cerebrospinal meningitis and scarlet fever, and accompanied by slight catarrhal changes, is due to a constant labyrinthine disease which defies all treatment.

So far as the nature of an ultimate treatment is concerned, it must be observed that general and special otological principles must be used as guides, and the treatment, in the majority of cases, should be local.

Treatment in other than the above-mentioned cases of deaf-mutism is, of course, justified when it is not accompanied by any danger to the patient, when it is indicated by otological principles, and when it is certain that the anatomical cause of the deafness is not situated in the brain. It is for the future to show what chance of improvement such cases have.

Urbantschisch's treatment is also worthy of mention. It consists in regular acoustic exercises, intended either to awaken or improve the power of hearing in deaf-mutes; and there is every reason to look forward to more exhaustive information as to the results of such treatment with considerable interest.

Instrument intended to facilitate treatment by Gellé's auditory exercises, and produce the voice automatically by means of clock-work with an intensity which is subject to regulation. It consists of a horizontal cylinder run by clock-work, on which wax is spread for receiving the registration. An apparatus placed in front of the cylinder bears a membrane with a rounded style, to which is attached a little special microphone, with micrometric vise, springs, and levers. An electric current is passed into the special microphone, and into a receiver like that of a telephone. When the receiver is brought to the ear, the words, or sounds, repeated by the phonograph are heard with an intensity which can be regulated at will by increasing the number of cells. By increasing the

force of the current the sounds can be made so intense as not to be endured without violent pain. Dussaud gives the receiver of a similar instrument devised by him to the deaf of all kinds and degrees. He is said to be able to make even deaf-mutes keep time to music and distinguish vowels and words. Each cylinder can repeat 10,000 times what it contains without any alteration. Re-engraved, this can be repeated forty times; thus each word can be repeated 400,000 times, and there are fifty words on a cylinder. A sixty-cell current is at first needed for the worst cases. At the end of a few months one cell will complete the process where a cure is being effected. The number of cells used makes the instrument an audimeter which measures the degree of deafness. On the principle of Urbantschisch and Gellé, who claim that many deaf ears need only education to give them a certain amount of hearing power, this apparatus should be of signal service in the teaching of deaf-mutes. Laborde (Practitioner, Apr., '98).

The above remarks on the treatment of deaf-mutism have exclusively dealt with the deafness from which the mutism results. I will not go further into the treatment of mutism by special methods of instruction, because this subject is not included in the aim of this article, which is prepared for those who are to give their attention to the diseases involved.

It will then be seen that when a child is proved to have such deficient power of hearing that mutism is the result, removal of that deaf-mutism by treatment can only be hoped for in very exceptional cases. Therefore, there is still greater reason for considering the question of the prevention of deaf-mutism. The principle method of obtaining this object must be to submit all children who suffer from deafness which threatens to cause, or has caused, deaf-mutism to a rational examination of the ears and of the adjacent mucous membranes, and eventu-

ally to make the existing disease the subject of rational treatment.

HOLGER MYGIND,
Copenhagen.

DELIRIUM TREMENS. See **ALCOHOLISM, ACUTE ALCOHOLIC DELIRIUM.**

DEMENTIA. See **INSANITY.**

DENGUE. See **SPECIFIC INFECTIOUS FEVERS.**

DERMATITIS.

Definition.—Inflammation of the skin.

Varieties.—There are seven varieties of dermatitis: dermatitis traumatica, due to traumatic irritation of the derma; dermatitis venenata, due to contact with poisonous agents; dermatitis medicamentosa; dermatitis herpetiformis; dermatitis gangrenosa; dermatitis maligna; and dermatitis exfoliativa.

Dermatitis Traumatica.

Under this heading are included such superficial inflammations of the skin as follow pressure, violence, contusions, abrasions from scratching or rubbing, or the action of mechanical irritants of any kind.

Case of dermatitis from Roentgen rays in a boy aged 16. On October 13th, to radiograph the spine, a Crookes tube was placed about 5 inches from the epigastrium, a flannelette shirt intervening between the tube and the skin, while the trousers were turned down on each side. An exposure of one hour was made, the coil being run by means of an accumulator. The next day the skin felt irritable and was of a deep-red color in the area subjected to the rays. The irritability increased, and, six days after the experiment, the skin felt stiff when he bent his body. Vesicles began to form, and they increased in size and number. The general surface was of a dusky or purplish red, forming an irregular band three-quarters of an inch wide round the umbilicus. On October 31st the whole of the epidermis had sep-

arated, and the skin was quite sound and level with the surrounding skin, except where the vesiculation had been most pronounced. The downy hairs with which the abdomen was rather thickly covered were still present on the site of the affected area. H. Radcliffe Crocker (Brit. Med. Jour., Jan. 2, '97).

Case of a man, aged 35 years, on whom an attempt was made to get a Roentgen photograph of the renal region. The exposure lasted one hour. Three hours later he felt nausea. Six days later another attempt was made, this time the exposure being with a somewhat stronger battery for an hour and a half. After the patient left he again felt nauseated. Next day the abdomen was slightly red; there was no itching or pain. On the third day redness was more intense. On the fourth day vesicles appeared, ran together, broke, and formed, eighteen days after the second exposure, a patch seven and a half by eight and a fourth inches. It looked like an irritative eczema, with exfoliated epidermis and a profuse sero-purulent discharge. Sixteen weeks after the second exposure the sore was three by three and a half inches and covered with a thick, leathery, insensitive, false membrane. H. C. Drury (Brit. Med. Jour., Nov. 7, '96).

The inflammation of the skin sometimes noticed in connection with fluoroscopic or sciagraphic observations is due to the absorption of radiant energy by the cells of the skin, and comparable to the changes effected in the photographic emulsion. Dermatitis appears more likely to ensue from exposure to low than to high vacuum-tube, the vast majority of rays with the former being unquestionably absorbed by the skin, while with the latter but few are absorbed. Jones (Jour. Amer. Med. Assoc., Nov. 6, '97).

The inflammatory action is usually simple, unless the tissues become infected by staphylococci or streptococci, when pus-formation or erysipelatous inflammation may follow. A common form of simple dermatitis is that resulting from chafing; while this, under the name *intertrigo*, is usually classed among

the congestive erythemas, it more frequently runs into true inflammation.

The most frequent sites for the intertriginous dermatitis are the armpits, perineum, and insides of the thighs and the under-surfaces of pendulous breasts, especially in corpulent women. It is more frequent in summer than in winter, as free perspiration, macerating the upper layers of the skin, and undergoing decomposition, with the formation of irritant compounds, promotes the occurrence of the inflammation.

Intertriginous dermatitis is very frequent in infants and young children, especially if great care is not taken to keep the genital and anal regions clean and dry. The most aggravated dermatitis of the genitals, insides of the thighs, and lower part of the belly may develop in a few hours in an infant allowed to lie in a wet and dirty napkin. The pain, itching, and burning are sometimes very intense, preventing sleep and keeping the child in a state of high, nervous tension, crying and irritable.

Treatment.—In simple traumatic dermatitis any soothing application will be useful. Cold cream, oxide-of-zinc ointment, or simple vaselin are usually sufficient to allay the inflammation. One of the best applications is hot water, applied for five or ten minutes several times a day. The water should not be merely warm, but as hot as can be borne without discomfort.

For intertriginous dermatitis the writer has found black-wash the best application. Applied on lint saturated with the preparation, it usually gives prompt relief from the burning and pain and controls the hyperæmia. A mild calomel ointment, $\frac{1}{2}$ drachm to the ounce of vaselin is also useful. In other cases Lassar's paste is useful. This is made as follows:—

℞ Acidi salicylici, gr. x.
 Pulv. amyli,
 Zinci oxidi, of each, ʒij.
 Vaseline, ʒss.
 M. ft. pasta.

Great care should be taken that only the finest powdered salicylic acid be used in making this and other ointments containing it. The crystallized acid usually proves extremely irritating to an inflamed or sensitive skin.

For the moderate grades of intertrigo or chafing, a simple dusting-powder of starch and oxide of zinc is generally sufficient, if the irritated skin be kept clean and dry. The interposition of a fold of lint or soft linen between opposing surfaces of skin is an aid to the cure as well as the prevention of intertriginous dermatitis.

Dermatitis Venenata.

Definition.—Inflammation of the skin produced by external irritating agents derived from the vegetable, mineral, or animal kingdoms.

Records of some unrecognized forms of dermatitis venenata. Thus, a papulovesicular eruption, accompanied by much heat and itching, may attack the hands and arms of persons employed in weeding parsnips, or in otherwise handling them. The upper part of the body of a man who had applied to his shoulder, on account of rheumatism, a mixture of hamamelis and laudanum, became covered with large vesicles, papules, and oozing areas. Here, no doubt, an idiosyncrasy to opium may have existed. The hands of a girl employed in dipping wooden toothpicks in oil of cassia, to give these an agreeable odor, were, in a few days after she commenced this occupation, inflamed, and covered with vesicles and moist areas; her face was red and blotchy, and the lower portion of the abdomen was similarly affected, probably from contact during sleep. A number of firemen, to whom new black cotton shirts had been issued as part of their summer uniform, became affected

with a brilliant-red infiltrated erythema on those portions of their body where the shirt came in contact. Solar heat and consequent perspiration seemed to have brought out the activity of the dye. Analysis proved the pigment an aniline one. James C. White (Boston Med. and Surg. Jour., Jan. 28, '97).

Outbreak of 34 cases of acute dermatitis among a number of workmen who had just been provided with new overcoats. On first wet day following the wearing of coats inflammation of the skin began to manifest itself on the back of the wrists, the only point at which the coat came in contact with the skin.

The patches were slightly depressed and had the appearance of a necrosis of the epidermis such as follows the application of a strong irritant. Tactile sensation was entirely lost in the affected areas, and the appearances were most marked in the neighborhood of existing abrasions. In three cases there was some inflammation of the arm, with enlargement of the axillary glands. Infusion of the cloth from which the overcoats were made yielded an acid reaction, and was found to contain zinc chloride, which caused the skin condition. Taunton (Lancet, Dec. 6, '98).

There are many common plants that will cause dermatitis, idiosyncrasy, however, playing an important part. The common plants are those of the rhus group—the poison-ivy, dogwood or poison-sumach, and the poison-oak. Japanese lacquer may cause it even in handling pictures. Among the ordinary wild flowers are the butter-cup, field-daisy, golden-rod, wood-anemone, clematis, and garden-nasturtium. Among the drugs used in applications, dermatitis may be caused by tincture of arnica, balm of Gilead, hamamelis, common salt in strong solution, belladonna, and many proprietary remedies containing the essential oils. Kerosene may cause an eruption. Glycerin, almond-oil, iodoform, carbolic acid, salicylic acid, quinine, sulphur, tar, and chrysarobin occasionally cause inflammation. Among substances brought into contact with the skin on account of occupation, and which may cause a dermatitis, are strong alkalis,

soaps, "pearline," "soapine," metal and shoe polishes, paint-pigments, arsenic, potassium bichromate, the various salts of mercury and even the metal, and chocolate. Animal irritants are the mosquito, flea, bed-bug, black fly, wasp, bee, hornet, spider, caterpillar, and jelly-fish. G. F. Harding (Boston Med. and Surg. Jour., Sept. 6, 1900).

Varieties.—(A) **DERMATITIS FROM VEGETABLE IRRITANTS.**—A large number of plants, some of them used medicinally, possess irritant properties when brought in contact with the skin.

Rhus, or *Poison-ivy*.—Among the above the most important are various species of *rhus*; namely *Rhus toxicodendron*, or poison-ivy; *Rhus venenata*, or poison-sumach; and *Rhus diversiloba*, or poison-oak. The latter, according to J. C. White, is a native of the Pacific coast, although the common *R. toxicodendron* is also vulgarly known as poison-oak.

When a person, susceptible to the poison of one of these species of *rhus*, touches the plant, or, in some cases, even comes within a short distance of the same, the skin shows signs of irritation manifested as follows: There may be redness, but more frequently the first objective sign is the eruption of groups of small vesicles, accompanied by swelling and intense itching. In consequence of the scratching set up, the vesicles are ruptured and exude an abundant serum. The swelling is sometimes very great, especially about the loose tissues of the face and the genital regions. The eruptions usually begin upon the hands, as these are the parts of the body most frequently brought in contact with the poison. From the hands it is generally transferred to the face, and next, in the male sex especially, to the genitals, because the face and genitals are the parts most frequently handled. The face and

head are often so intensely swelled as to be almost unrecognizable.

[I have a vivid recollection of a personal attack of this eruption. When a boy I had frequently exposed myself to the poison without becoming affected. After a residence of some years in the city, I deliberately exposed myself, on a visit to the country, and within twenty-four hours my hands and face were swelled, covered with vesicles, and intensely itching. In the course of the next twelve hours the genital organs became swelled and studded with vesicles. Sleep was impossible from the most intense irritation. The scratching produced erosions, exudations of serum, and the formation of crusts, which finally fell off, leaving a slightly-red-dened and somewhat exuding surface beneath. The itching was only partially controlled by the frequent application of concentrated solution of common salt. The eruption lasted about a week.

GEORGE H. ROHÉ.]

Sometimes the skin is very much reddened and the exudation abundant. Excoriated patches are frequent. The itching varies from mild grades to the most severe intensity, but is generally a prominent symptom. It is said that death has followed the poison, but the testimony upon this point is rather vague.

The common belief that an eruption caused by *rhus* poisoning is liable to recur annually without renewed exposure is not based upon sufficiently-definite evidence. The fact that the dermatitis recurs at about the same time each year is to be attributed to a new exposure. White, however, mentions a number of cases in which a different eruption followed—after an interval—the attack of *rhus* poisoning.

The chemical nature of the poison of the various species of *rhus* is somewhat obscure, but a number of researches indicate that it is a volatile acid. A number of cases are on record showing that

handling dried specimens of the poisonous plants may produce an eruption. The time after exposure when the eruption appears differs in different persons. The shortest is, perhaps, four or five hours, while in some cases it may be as many days before the effects of the poison on the skin are manifested. That the poison before volatilization may be transferred from one portion of the body to another—as from the hands to the face or to the genitals—is beyond question.

Case of dermatitis venenata conveyed to a patient in the obstetrical ward of a hospital by the attendants, who had, just before the patient's delivery, gathered a quantity of poison-ivy, and then, although having previously carefully washed their hands, had manipulated the patient's abdomen. J. Abbott Cantrell (Med. News, Oct. 24, '91).

It has been hitherto accepted that the toxicodendric acid described by Maisch was the active principle of *rhus* poisoning, but found to be merely acetic acid. A poisonous oil, however, termed "toxicodendrol," is the toxic element,—a very intense skin irritant, even in minute quantity. Like cantharides, it can produce nephritis and fatty degeneration of the kidneys, and it is probable that fatal results of *rhus* poisoning may have been due to renal complications. It is non-volatile; actual contact appears necessary. The activity of toxicodendrol in minutest traces may make it possible for a few pollen grains of poison-ivy to cause skin eruption; and the few cases of action at a distance, which are so often quoted, may conceivably be thus explained.

The rational indication is to get rid of the poisonous oil which may be on the skin as quickly as possible; the parts should be well washed, and scrubbed with soap and water, or alcohol. Fatty preparations, being oil solvents, if used, tend but to spread the evil. Pfaff (Jour. Exp. Med., Mar., '97).

Poisoning from the action of the *Rhus toxicodendron* is differentiated from eczema by the vesicles being much more

numerous, swelling and œdema being greater, and exposed parts being more likely to be affected, particularly the inner surfaces of the fingers, while the eczematous eruption is more frequently polymorphous. Sun-burn sometimes resembles dermatitis venenata, but it is more diffuse, and is usually localized entirely to exposed parts, while *rhus* poisoning affects the breasts and genitalia also. Scabies is excluded by the history and by the absence of the *Acarus scabiei*. J. Sobel (Med. Rec., Nov. 5, '98).

Blastomycetic dermatitis is due solely to the invasion of the skin by one of the plant forms of the yeast family. In its clinical aspect it resembles lupus vulgaris in the ulcerative stage. Hyde, Hektoen, and Bevan (Brit. Jour. of Derm., July, '99).

Treatment.—The most effective applications in the early stages of *rhus* poisoning are alkaline solutions, soap being especially useful on account of its detergent effect. By its early use, the greater portion of the poison can be removed, or its effects neutralized, before it has had time to penetrate the skin and act as an irritant. Solutions of bicarbonate of soda, 1 ounce to the pint, and black-wash usually relieve the itching promptly. Hardaway, of St. Louis, recommends very highly a lotion of zinc sulphate, $\frac{1}{2}$ drachm to the pint of water. Fluid extract of grindelia robusta, either full strength or diluted with water in various proportions, is highly lauded by Van Harlingen and others. When the vesicles have ruptured, drying or absorbent powders of starch, chalk, oxide of zinc, orris-root, lycopodium, etc., may be used with good effect. Astringent lotions, among which acetate of lead holds a high place, are especially useful when the eruption is fully developed.

James C. White, of Boston, recommends the following prescription:—

R Zinci oxidi, ʒiv.
 Acidi carbolici, ʒj.
 Aquæ calcis, Oj.—M.

This should be applied freely and repeatedly over the affected parts. It alleviates the intense itching and hastens the involution of the inflammatory process. Internal remedies are unnecessary and useless.

In the treatment of dermatitis venenata, good results obtained with a modified "Burrow solution," containing 1 drachm of lead acetate and 3 drachms of alum to a quart of water. Picric acid, in a 1-per-cent. solution, is also useful. Salol in a 3-per-cent. solution is especially good. J. Sobel (Med. Rec., Nov. 5, '98).

Remedy for dermatitis venenata upon which most reliance is personally placed is sodium hyposulphite, in the strength of $\frac{1}{2}$ ounce to 2 ounces dissolved in a pint of water. The affected part is mopped freely and frequently, or wrapped up in a cloth or bandage saturated with the fluid, which is renewed as soon as the dressing has become dry. E. S. Gans (Med. Bull., Aug., '99).

Dermatitis venenata successfully treated by using locally a 10-per-cent. solution of ichthyol and a 1 to 5000 solution of mercury bichloride; internally, a calomel purge followed by capsules of quinine, guaiacol carbonate, and phenacetin every four hours. J. A. Colnane (No. Amer. Jour. of Diag. and Pract., iii, 4, p. 13, 1900).

Arnica and Other Toxic Agents.—The tincture of arnica is so freely used as an external application to bruises and sprains that it may be useful to the practitioner to know that it sometimes produces a decided dermatitis, which may be accompanied by vesiculation. The cessation of the application, and dressing the affected part with a soothing or mildly-astringent lotion (bicarbonate of soda, borax, sulphate of zinc) will generally suffice to restore the normal condition of the part.

Among other agents used for medicinal purposes, which produce dermatitis of varying intensity, are mustard, cowhage, chrysarobin, ipecac, capsicum, mezereum, thapsia, cantharides, oil of turpentine, tar, creasote, paraffin, petroleum, pyrogallic and salicylic acids, chloral-hydrate, sulphur, iodine, mercurial preparations, and the more active alkaline, acid, and mineral caustics.

The knowledge may also be useful that the juice of the common buttercup of the fields and the garden nasturtium may cause inflammation of the skin.

Dermatitis caused on four occasions by using iodoform in as many patients operated on. In the second instance the hand also had accidentally come into contact with the iodoform; this led to dermatitis of the area thus exposed. On the two latter occasions the dermatitis was accompanied by erysipelas, and led to prolonged pigmentation. This shows that no breach in the skin is required to produce this inflammation. Matschke (Ther. Monats., Oct., '93).

Case showing untoward effect of resorcin applications: a single application sufficient to set up a violent dermatitis. R. W. Taylor (Jour. of Cut. and Genito-Urin. Dis., Apr., '95).

[These artificial eruptions provoked by resorcin are relatively frequent, and this substance should only be used with much precaution, beginning with almost infinitesimal doses and suspending its use at the slightest sign of irritation. L. Brocq, Assoc. Ed., Annual, '96.]

(B) DERMATITIS FROM ANIMAL IRRITANTS.—Among cases of dermatitis venenata of animal origin may be included the cutaneous inflammations caused by the stings and bites of insects, such as bees, wasps, fleas, bed-bugs, lice, and mosquitoes. The inflammatory effects vary in different persons. While in most cases the bite of a mosquito will produce simply a small, itching papule, in others, large red, painful lumps are raised, which

give rise to great discomfort and often alarm. The treatment is purely symptomatic. Alkaline lotions are generally most effective. [See WOUNDS, POISONED. ED.]

Dermatitis Medicamentosa.

Definition.—Inflammation of the skin caused by the action of medicinal agents taken into the system.

Very many medicines when administered for therapeutic purposes produce, among other by-effects, inflammation of the skin. This may find expression in erythematous, papular, vesicular, bullous, tubercular, or ulcerative lesions. No distinctive diagnostic marks can be given for these eruptions, but the occurrence of any eruption, not readily explained by other causes, should lead to an inquiry concerning the possible effect of medicines ingested. Thus, an eruption almost identical in appearance with that of scarlet fever at times follows the administration of quinine.

[I have seen this twice in the same subject, who had already passed through an attack of scarlet fever. GEORGE H. ROUÉ.]

In the quinine eruption the high fever and sore throat of scarlatina are absent. A bullous eruption, resembling pemphigus, may follow the ingestion of iodide of potassium, which drug may also produce tubercular, pustular, and ulcerative lesions. A papulo-erythematous eruption, suggestive of measles, occasionally follows antipyrine. Copaiba may cause a macular eruption resembling the erythematous syphilide. The scarlatiniform rash of belladonna is well known. In some susceptible subjects opium preparations, in addition to itching, may also give rise to an urticarial or erythematous eruption.

VARIETIES OF ERUPTION OBSERVED AFTER INGESTION OF DIFFERENT DRUGS.
—Erythematous and erythemato-papu-

lar eruptions are sometimes observed after taking belladonna, hyoseyamus, stramonium, quinine, nitrite of amyl, chloroform, arsenic, opium, turpentine, cubebs, copaiba, antipyrine, and benzoate of sodium. Sometimes these are attended with more or less severe itching, and may resemble urticaria. (See various remedies in which these manifestations occur.)

Case of dermatitis medicamentosa diffusa following upon a dose of opium. The whole skin became red and covered with large scales. The skin was dry. Movements were interfered with on account of the pain in the skin. The epidermis was shed in large plates so as to form complete casts of the hands and feet. The normal lines of the skin were accentuated. The mucous membrane of the mouth was dry and red. The patient complained of tenseness of the skin, chilliness, thirst, loss of appetite, headache, and insomnia. Lanz (*Monats. f. Prakt. Derm.*, No. 309, '93).

Mixed erythematous rashes (polymorphous erythema) have occurred after the administration of arsenic, quinine, digitalis, copaiba, and bromide of potassium.

Vesicular and bullous eruption may follow arsenic (herpes zoster), cannabis Indica, iodide and bromide of potassium, quinine, salicylate of sodium, and phosphoric acid.

Pustular and phlegmonous eruptions (pustules, boils, abscesses, diffuse phlegmonous or erysipelatous inflammation) have been noted after taking iodide and bromide of potassium, arsenic, quinine, hyoseyamus, opium, chloral-hydrate, digitalis, iodide of mercury, calomel, and pilocarpine.

[I have observed a large multinodular, tubercular eruption follow the continued use of large doses of iodide of potassium. Under the supposition that the eruption was syphilitic in origin, the dose of the iodide was increased, with

the effect of aggravating the eruption. The suspicion that the lesions might be due to the iodide led to a discontinuance of the drug, when the nodules rapidly disappeared. GEORGE H. ROHÉ.]

Superficial ulcerations about the roots of the nails sometimes follow the prolonged administration of chloral-hydrate.

Purpuric extravasations have been noted after iodide of potassium, salicylic acid, quinine, chloral-hydrate, and camphor.

Treatment.—The treatment of drug eruptions must be symptomatic. The administration of the remedy must be stopped, and other indications met as they arise.

Dermatitis Herpetiformis.

Definition.—An inflammatory, superficially-seated, multiform, herpetiform eruption, characterized mainly by erythematous, vesicular, pustular, and bullous lesions, occurring usually in varied combinations, accompanied by burning and itching, pursuing usually a chronic course with a tendency to relapse and recur. (L. A. Duhring.)

The acute observations and logical reasoning of Duhring with reference to this disease have led to a general acceptance of his views on the part of dermatologists. At one time Duhring classed the disease first described by Hebra under the name of "impetigo herpetiformis," as the pustular variety of *D. herpetiformis*, but in his latest publication ("Cutaneous Medicine," Part II) he regards it as advisable to consider the two diseases as distinct "from a clinical stand-point, at least." Unna and Stephen Mackenzie lay stress upon the neurotic origin of *D. herpetiformis*.

Symptoms.—Duhring, upon whose exhaustive studies the following description is based, recognizes five varieties of the disease, namely: the erythematous,

vesicular, bullous, pustular, and multiform, indicating the prevailing type of lesion present.

There is usually a prodromic febrile stage, which, however, rarely amounts to more than slight chilliness, flushing, or heat, with the accompaniments of malaise and constipation. Itching may precede the outbreak of the eruption. Any one variety of lesion may appear, or there may be from the beginning a combination of two or more of them. The type of lesion may change during the course of the disease, or, as is more rare, may remain constant throughout the attack, and may also show the same features in subsequent attacks. The subjective sensations are burning, itching, and prickling, which may be severe. In one case of the vesiculo-pustular variety, the itching and burning were most intense, relief being obtained only after the application of strong ointments or lotions of cocaine.

The *erythematous* variety occurs in patches or diffused over the surface. There is usually slight elevation of the affected skin. The red color of the eruption may be varied by a yellowish or brownish tint, and is usually followed by more or less pigmentation.

The *vesicular* variety is the most common. The vesicles are irregular in size and shape, usually tense, and rising abruptly from an apparently normal base. They may be disseminated or aggregated in groups or clusters. They sometimes coalesce to form small blebs. The itching is usually more intense than in other forms of eruption. After the vesicles rupture there is often some relief from this symptom. Excoriation is usually not very marked.

In the *bullous* variety the bullæ are usually tense, standing out from the level of the skin. They are usually ir-

regular in outline, differing from the bullæ of pemphigus. They are also more likely to appear in groups or clusters. Vesicles and pustules may accompany the blebs.

The *pustular* form appears pustular from the beginning. The lesions are either acuminate, discrete, up to a pea in size, or flat, not elevated above the skin, aggregated in small groups, and miliary in size. The larger pustules often have a puckered appearance.

The *multiform* variety is made up of all the various types of eruption in combination, and has suggested one of the names by which the disease is known, viz.: *dermatitis multiforme*. The lesions are macules, papules, vesicles, pustules, and bullæ of all shapes and sizes. There are excoriations and pigmentations of a brownish color. The character of the lesions is constantly changing.

Dermatitis Herpetiformis. — The course of the disease is a chronic one, and it may last, appearing and disappearing at intervals for many years. Treatment has usually little effect upon its progress.

Two cases of symptomatic dermatitis occurring in puerperal women. In the first case the eruption appeared as a papular erythema on the fifth day post-partum, while in the second it was a bright-red flush on the eighth day after labor. Wilson (Annals of Gynec. and Ped., May, '91).

Herpetiform dermatitis in pregnancy is a rare disease, little known even to obstetricians. It is distinguished by five principal characteristics: 1. A polymorphous eruption, with a predominance of bullous vesicles; simple vesicles, bullæ, pustules, erosions, crusts, and spots were met with at the same time. 2. An accompanying pruriginous disease, really painful. 3. Good general health. 4. Successive attacks of the disease. 5. A chronic character, aggravated by each attack of the disease, which may last

for some years. Fournier (Jour. de Méd. et de Chir. Prat., Oct. 10, '92).

Four cases of Dühring's disease in which glycosuria was a symptom. Winfield (Jour. of Cut. and Genito-Urin. Dis., Nov., '93).

Two cases in two sisters living apart, interesting as showing family tendency, liability to onset in a predisposed person on change of climate, and general intractability of the complaint. J. J. Mooney (Med. Age, Aug. 10, '95).

Case of typical recurrent dermatitis herpetiformis, the lesions consisting of a central bulla surrounded by an areola of spreading centrifugal erythema. Between this areola and the collapsed original bulla a ring of vesicles frequently made their appearance. It is uncommon to have the lesions of dermatitis herpetiformis so closely simulating erythema multiforme. John Liddell (Brit. Jour. of Derm., p. 385, '96).

Etiology. — It sometimes begins in childhood, but most frequently between 30 and 40 years of age. There seems to be some connection between the disease and instability of the nervous system, but nothing is definitely known upon this point. There seems to be a frequent relation between the eruption and pregnancy, the puerperal state, or menstrual disturbances. The disease described by Bulkley and others as "herpes gestationis" is probably a vesicular or vesiculo-bullous form of *D. herpetiformis* occurring during pregnancy. There seems, also, some connection between renal defect and *D. herpetiformis*. It has been observed after septic infection.

Case of dermatitis herpetiformis in a woman of 42 with a rheumatic history. She suffered in 1895 from a stuffed-up feeling in the eyes, nose, and throat, and soon after blisters came out on the tongue; a little later on the chin; a hot bath was followed by a copious eruption of vesicles on the face and arms, which swelled greatly, and also on the chest and thighs. Fresh eruptions appeared consecutively, with soreness

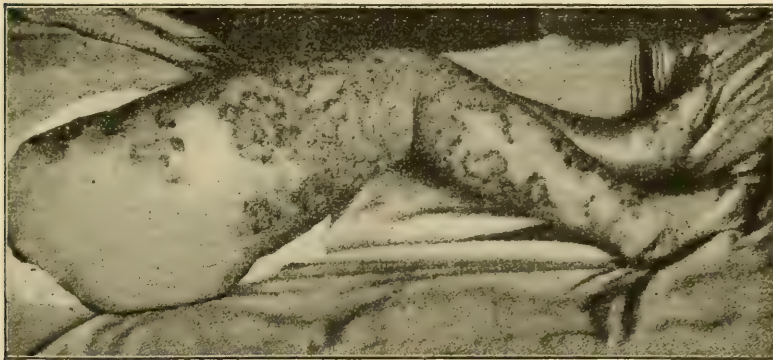
in the mouth, eyes, and nose, and violent paroxysmal itching and burning of the affected areas. The attacks continued, and in November, 1896, the vesicles were both discrete and confluent, and also multilocular. Considerable eosinophilia of the compound-nuclear, coarsely-granular type were found in the blood, the eosinophiles reaching 4.9 per cent. of all leucocytes present.

Again, when the eruption was at its height, the eosinophiles reached 12 per cent. of all leucocytes present in four specimens. The disease seems to exhibit the same features of multiformity, recurrence, and obstinacy in the natives of India as among white races. Morris

Fig. 1 shows two vesicles (V_1 , V_2) which have been formed entirely beneath the epidermis. Macroscopically both vesicles were about the size of a small pin-head. The entire upper half of the corium is the seat of acute inflammation. *S* is a sweat-duct; *B* indicates small blood-vessels, and *G* is a sebaceous gland.

Fig. 2 shows the stage preceding the formation of the vesicles. Large numbers of eosinophiles (*E*) are to be seen scattered throughout the papillæ.

Fig. 3 shows the first stage in the formation of the vesicles. Immense



Dermatitis herpetiformis. (Liddell.)

and Whitfield (Brit. Jour. of Derm., June, '97).

Case of dermatitis herpetiformis in a child, 3 years of age, cured by circumcision. The disease was being kept up by the reflex irritation caused by phimosis. J. N. Roussel (New Orleans Med. and Surg. Jour., June, 1900).

Pathology.—The pathological histology of dermatitis herpetiformis has been most thoroughly studied by Gilchrist, and the histological characters of the affection are shown in the illustrations on page 414, representing sections from a case of dermatitis herpetiformis (Duhring).

numbers of polynuclear leucocytes are massed in the papillæ, having replaced the normal tissue.

Post-mortem in a case. 1. Absence of bacterial specificity in contents of bullæ. 2. Coincidence noted by Brocq of lesions of nervous system. 3. Co-existence of bullous lesions and nephritis. Gastou (Le Bull. Méd., Apr. 21, '95).

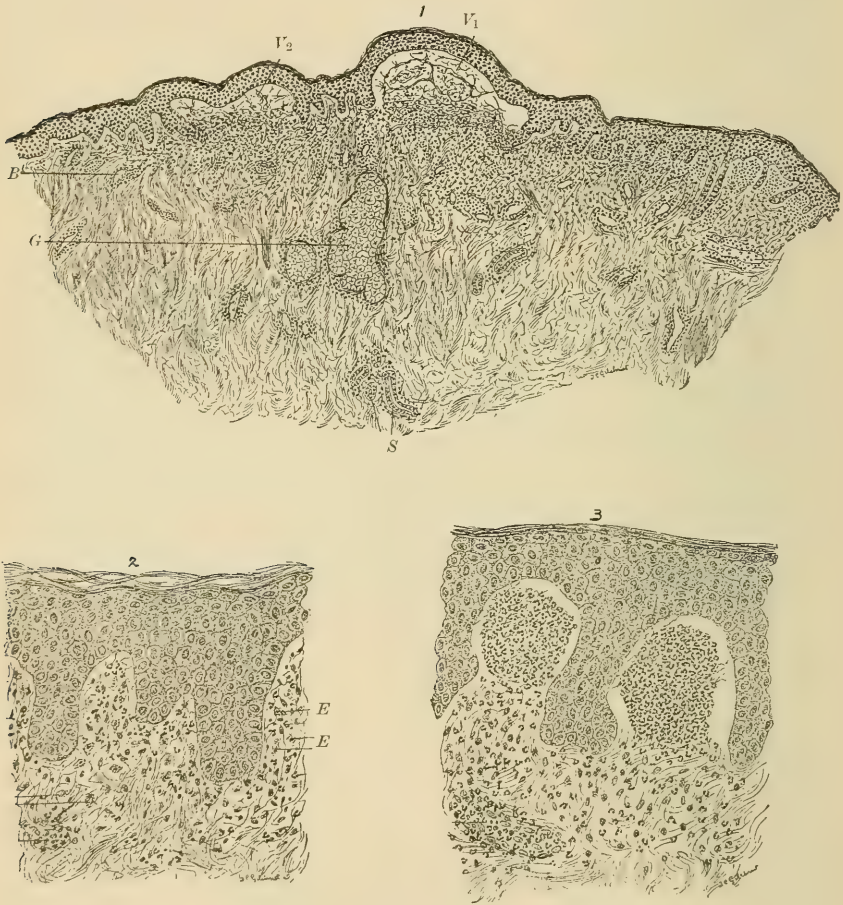
Diagnosis.—The multiformity of the lesions and the tendency to their herpetic arrangement, which Duhring regards as characteristic; the chronicity of the disease, and its frequent recurrence; the burning and itching, and general absence of marked constitutional disturb-

ance will usually enable a diagnosis to be made without difficulty. Among the diseases which may cause doubt are pemphigus, herpes, erythema multiforme, and eczema.

PEMPHIGUS.—The lesions are usually well-formed large blebs, rising abruptly

tended by moderate pain and burning; no itching; the blisters are usually small and aggregated in groups. The course of the disease is acute.

ERYTHEMA MULTIFORME.—In this affection there are rarely vesicles, blebs, and pustules, though these may be pres-



Sections from a case of dermatitis herpetiformis. (Gilchrist.)

from a normal skin, usually discrete, not attended by itching or burning, and drying up in the course of a week. Successive crops of these blebs are likely to appear.

HERPES.—The lesions are vesicular, appear upon an inflamed base, and at-

ent. The extremities are usually attacked, and the distribution of the eruption is symmetrical. The color of the lesions is a dusky red or brownish; no itching and but slight pain and burning.

ECZEMA may cause most difficulty in differentiation. The vesicles in this dis-

ease are usually easily ruptured by scratching, and the discharge of serum is abundant. Except in very acute cases, the burning sensation is not as severe as in *D. herpetiformis*. The scratching is followed by much more notable excoriation in eczema than in the disease under consideration.

IMPETIGO HERPETIFORMIS OF HEBRA, which was at first regarded by Duhring as merely a variety of *D. herpetiformis*, is now conceded by him to be a distinct disease. Its lesions are always pustular. It nearly always occurs in pregnant women, or during the puerperal period; is attended by symptoms of grave constitutional involvement, and generally terminates fatally. In some cases, prolonged observation will be necessary to make a definite diagnosis.

The value of the new diagnostic sign between pemphigus and dermatitis herpetiformis first formulated by Leredde and Perrin confirmed. This consists in the simultaneous presence, in the latter disease, of eosinophile-cells in the blood and in the serum of the bullæ. In two cases examined at intervals of fifteen days the eosinophile-leucocytes and granules were found in abundance. On the contrary, in an instance of pemphigus foliaceus the eosinophile-cells were entirely absent from the blood and serum on the first and second examinations; also at an interval of fifteen days; in the blood only were found a very few eosinophile-leucocytes containing well-stained eosinophile-granules. Hallopeau and Lafitte (*Ann. de Derm. et de Syph.*, Dec., '96).

Case resembling pemphigus and dermatitis herpetiformis, though a history of recent illicit intercourse seems for a time to have raised a suspicion, apparently erroneously, of syphilis. It occurred in a lad of 21, depressed and slightly feverish, with a profuse bullous eruption, discrete and well formed, on the lower limbs, but sparingly on the trunk, present also on the mucous membrane of the mouth. Itching was

marked. In the course of two or three months the entire body became attacked. With this there was a dark-brown pigmentation and a disagreeable odor, and the temperature was continuously above 101.5° F. No examination for eosinophiles was made. Biddle (*Jour. Cutan. and Genito-Urin. Dis.*, May, '97).

Prognosis.—The prognosis, so far as life is concerned, is usually favorable, but the disease is generally chronic in duration, and has a marked tendency to recur. Duhring has reported cases lasting thirteen and fourteen years.

Treatment.—The treatment of dermatitis herpetiformis is far from satisfactory. In some cases the lesions yield promptly to local applications, while in others, as Duhring states, the lesions develop, relapse, and recur from time to time in spite of the most varied measures employed. The internal treatment should be directed toward the improvement of the general health, and the ascertainment and removal, if possible, of disease or disorder of the stomach, intestines, or kidneys. The apparent close connection of the nervous system with the etiology of the disease would lead one to expect benefit from neurotic remedies, such as arsenic, phosphorus, and strychnine. Unfortunately, neither of these can be relied upon in all cases, though some show distinct improvement after the use of the first named.

Cannabis Indica, chloral, opium, and antipyrine have been tried as sedatives and anodynes; but little benefit can be expected from them.

Local applications likewise are often disappointing. Dr. Duhring has had most success—in the vesicular, bullous, and pustular forms—from a strong sulphur ointment, 2 drachms to the ounce, applied with sufficient friction to rupture the lesions. In the erythematous form soothing applications are indicated.

Tar, in the form of liquor picis alkalinus, 1 drachm to 8 ounces of water, or liquor carbonis detergens of the same strength may be used with benefit in some cases. They relieve the itching, but have apparently little influence upon the progress or duration of the eruption. A 2-per-cent. ointment of cocaine is also of value as a local anodyne when the burning and itching are severe.

Ichthyol, resorcin, carbolic acid, salicylic acid, and thiol have been used, but without much success. A hot bath before retiring sometimes gives grateful relief from the subjective symptoms.

In dermatitis herpetiformis most relief gained by lotions of chloroform-water, followed by dusting with powdered talc and inunction with a calomel-and-belladonna ointment. Dubreuilh (*Revue de Thér. Medico-Chir.*, Mar. 1, '89).

Case of a man, aged 51, who suffered from general furunculosis followed by a general bullous eruption. The author considered it a malignant form of dermatitis herpetiformis. After failure of other treatment, cacodylate of soda was given up to 20 centigrammes (3 grains) daily. This was afterward changed to hypodermic injections. After several weeks of this treatment the whole disease improved, and a considerable part of the body became healthy. Davezac (*Gaz. des Hôp. de Toulouse*, July 13, 1901).

Dermatitis Gangrenosa.

Definition.—Inflammation of the skin accompanied by sloughing or gangrene.

Etiology.—Gangrene or sloughing may follow any lesion of the skin severe enough to destroy its vitality. Thus it sometimes follows intense or long-continued pressure, severe contusions, violent inflammation, or some profound nervous disturbance. The ordinary bed-sore is an example of gangrenous dermatitis from pressure; the acute or neurotic bed-sore follows a neuritis or other disease of the peripheral nerves. In se-

vere contusions, the application of caustics, deep burns, or frost-bite the slough is due to the sudden and violent arrest of nutrition in the part. Diabetes is not rarely accompanied by gangrene. The interesting affection known as Raynaud's disease, whose most marked manifestation is symmetrical gangrene of the extremities, cannot properly be described as a gangrenous dermatitis.

A gangrenous dermatitis of infants has been described under various names. It occurs most frequently after varicella in children debilitated by innutrition or constitutional dyscrasiæ. The lesions consist of ulcerations under a black slough of varying thickness, and occupying the site of one of the pustular or bullous lesions of the disease. The same lesion is not infrequently observed in vaccination, especially with bovine lymph. It is probable that the gangrene is due to an infection by micro-organisms, but the nature of these has not been determined. This form of localized gangrene may also follow other skin diseases.

Ten cases of typhoid fever complicated by gangrenous dermatitis. All the patients were young men who went out as soldiers in the Spanish war. Bacteriological examinations from unbroken vesicles and from ulcers showed the staphylococcus albus and aureus; indifferent bacteria, as cocci and diplococci, were found in cultures from an ulcer. The disease is inoculable. The gangrenous patches appeared on the trunk, face, arms, thighs, and in two instances on the scrotum. The extremities were attacked in but one case. B. F. Stahl (*Amer. Jour. Med. Sci.*, Mar., 1900).

Treatment.—The treatment of gangrenous dermatitis consists in the application of stimulant and antiseptic lotions or ointments.

Dermatitis Maligna.

Definition.—An inflammation of the

skin with a tendency to malignant degeneration.

Symptoms.—The terms “malignant dermatitis” and “malignant papillary dermatitis” are applied to an inflammation, almost exclusively limited to the mamillary portion and areola of the mammary gland, and generally known as “Paget’s disease of the nipple.” It has much the appearance of an eczema rubrum, and is nearly always followed by epitheliomatous infiltration.

Sir James Paget, who first described the affection in a classical paper in the St. Bartholomew’s Hospital Reports for 1874, gives the following account of its clinical history:—

“The patients were all women, varying in age from 40 to 60 or more years, having in common nothing but their disease. In all of them the disease began as an eruption on the nipple and areola. In the majority it had the appearance of a florid, intensely-red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed; like the surface of very acute diffuse eczema, or like that of an acute balanitis. From such a surface, on the whole or greater part of the nipple or areola, there was always copious, clear, yellowish, viscid exudation. The sensations were commonly tickling, itching, and burning, but the malady was never attended by disturbance of the general health. I have not seen this form of eruption extend beyond the areola, and only once have seen it pass into a deeper ulceration of the skin after the manner of a rodent ulcer. . . . But it has happened that, in every case which I have been able to watch, cancer of the mammary gland has followed within, at most, two years, and usually within one year. The eruption has resisted all treatment, both local and general, that has been used, and

has continued even after the affected part of the skin has been involved in the cancerous disease.”

The only fact that can be added to this description, after twenty-four years’ further observation, is that the disease is not exclusively located upon the nipple of women, but that it may involve the nipple of the male or may occur upon other portions of the body. The inflamed patch of the nipple and areola is usually decidedly indurated, with an elevated border, and gives the sensation, when pinched up, of a button inserted in the skin.

Pathology.—It is not definitely known whether the disease is epitheliomatous from the start, or whether it begins as an eczematous dermatitis and becomes malignant in consequence of the epitheliomatous degeneration of the skin. The glandular structures of the nipple are especially liable to malignant degeneration, and it is probable that any long-continued irritation of the epithelial elements would be followed, in persons with a predisposition to epithelial overgrowth, by malignant disease. Upon this assumption, the view that the primary disease is an eczema or a dermatitis, and that malignancy is secondary, is a rational one.

Microscopical studies of the disease by Thin and Wile have shown the epithelial infiltration present at a very early stage. It may be said, however, that when the diagnosis of malignant dermatitis or Paget’s disease can be made, the trouble is no longer an eczema, whatever it may have been at an earlier period.

Case of malignant papillary dermatitis occurring on the breast of a woman of 45. The morbid changes are inflammation of the papillary layer, with œdema and vacuolation of the epidermic cells, the latter being followed by

complete destruction or by abnormal proliferation in different situations. Secondary to these changes there is proliferation of the lining of the galactiferous ducts and glands. The proliferated cells finally break through the basement-membrane into the surrounding tissue, at which point malignant infection begins. F. H. Wiggin and J. A. Fordyce (*N. Y. Med. Jour.*, Oct. 2, '97).

Diagnosis.—Diagnostic features of malignant dermatitis as differentiated from eczema of the nipple are:—

1. Its occurrence in women over 40 years of age, while eczema of the nipple is more frequent in the child-bearing age, and especially during lactation.

2. The affected surface is red, raw, and granular-looking.

3. There is decided superficial, well-defined induration in place of the diffuse, leathery infiltration of eczema.

Finally, while eczema is often obstinate, it usually yields to proper local treatment; while malignant dermatitis is not curable by any means short of cauterization or removal with the knife.

Treatment.—In reference to the treatment of malignant dermatitis, Sir James Paget said in his paper above referred to: "In practice the question must be sometimes raised whether a part, through whose disease or degeneracy cancer is very likely to be induced, should not be removed. In the member of a family in which cancer has frequently occurred, and who is at or beyond middle age, the risk is certainly very great that such an eruption on the areola, as I have described, will be followed within a year or two by cancer of the breast. Should not, then, the whole diseased portion of the skin be destroyed or removed as soon as it appears incurable by milder means?"

The answer to the question is self-evident, in view of the history of the disease. If a diagnosis of malignant derma-

titis is positively made, there can be no other rational treatment than such as would be appropriate for epithelioma; namely: destruction of the diseased skin by cautery or caustics, or removal of the entire breast. In cases of doubt, the approved remedies for eczema may be tried, but too much time should not be wasted in temporizing expedients.

Pyrogallic-acid ointment, 3 drachms to the ounce; lactic acid; chloride-of-zinc paste, of varying strength; chromic acid and arsenical pastes, the best of which is Marsden's (\mathcal{R} *acidi arsenosi*, *pulv. g. acaciæ*, of each, *p. e.*; mix and make a stiff paste with water just before using), may all be used with good effect. Chromic acid in concentrated solution is the least—Marsden's paste the most—painful of these applications. The arsenical paste should not be applied over a surface of more than one square inch at a time, as otherwise sufficient arsenic may be absorbed to cause symptoms of poisoning. The pain of the application is very severe, and as the caustic must remain upon the part at least twenty-four hours, the suffering is always considerable. When the paste is applied a piece of lint is pressed upon it which absorbs the surplus and prevents its spreading. After twenty-four hours, a poultice is applied, which soon causes a separation of the slough. The resulting ulcer is usually healthy in appearance and heals readily under simple applications, if all the degenerated tissue has been destroyed.

The galvanocautery and thermocautery are trustworthy methods for destroying the morbid tissue.

When the area involved is large, the best treatment is thorough extirpation of the entire breast.

Dermatitis Exfoliativa.

Definition.—Inflammation of the skin,



General Epidemic Exfoliative Dermatitis. (Byrom Bramwell.)

ATLAS OF CLINICAL MEDICINE.

acute or chronic, accompanied by exfoliation of the epidermis.

Varieties.—(A) Acute exfoliative dermatitis of infants.

(B) Chronic general exfoliative dermatitis.

(C) Local exfoliative dermatitis.

(D) Epidemic exfoliative dermatitis.

(A) Acute Exfoliative Dermatitis of Infants.

Definition.—An acute inflammatory affection of the skin of infants, accompanied by exfoliation of the epidermis in flakes, running a rapid course, and in most cases ending fatally.

Symptoms.—The disease was first described by Prof. Ritter von Rittershain, of Vienna. He had observed nearly three hundred cases in the course of ten years.

The children attacked were nearly all between 2 and 5 weeks old. A prodromal stage, characterized by abnormal dryness of the integument, with furfuraceous epidermal desquamation, usually occurred. The skin of the lower part of the face, especially about the angles of the mouth, becomes red and slightly tumid. The margin of the redness, which rapidly spreads, is indistinct, not being sharply defined against the healthy skin. The skin at the angles of the mouth becomes fissured and covered with scabs. The mucous membrane lining the pharynx and buccal cavity is reddened, and the palatal arch is the seat of superficial erosions, covered by a grayish-white exudation.

The appetite and digestion remain unimpaired. There is no fever. The redness and thickening of the skin extend over the entire body. The face becomes covered by yellowish, translucent scabs upon a reddened base, intersected in various directions by fissures. The skin becomes wrinkled, and the upper layer sep-

arates from the cutis. The epidermis may be detached in large flakes or in scales. This process, continuing until the entire surface is denuded of epidermis, presents an appearance similar to that following an extensive scalding. In favorable cases the dark, raw-flesh color of the cutis soon gives way to a lighter red, and in some cases the normal color of the skin is restored in twenty-four to thirty-six hours. In unfavorable cases, on the other hand, the color is a dirty brownish-red, and the cutis becomes dry and parchment-like. In those cases which terminate in recovery, the normal condition is entirely re-established in a week or ten days, the skin for a few days being covered by a fine, branny desquamation.

As sequels, eczemas of considerable extent, or small, superficial boils and abscesses, sometimes in large numbers, occur, and delay recovery. At other times extensive phlegmonous infiltrations occupy considerable tracts of skin, and may result in gangrenous destruction of tissue and death. In the latter conditions pneumonia and colliquative diarrhoea not rarely precede the fatal termination. Relapses are rare. The disease is ascribed to a septic or pus infection localized upon the skin.

Diagnosis.—In typical cases, no difficulty should occur in diagnosis. Erysipelas, which sometimes closely resembles this disease, is easily excluded by the high temperature of the former. In pemphigus there are distinct bullæ separated by normal skin. In exfoliative dermatitis the redness and thickening are progressive and finally occupy the entire surface.

Case of dermatitis exfoliativa pigmentosa in which the disease bore a close resemblance to the pityriasis rubra of Devergie, with the exception of the pigmentation, which was very intense.

Henry Handford (Brit. Jour. of Derm., Mar., '94).

Prognosis.—This is decidedly unfavorable. In Rittershain's cases the mortality was about 50 per cent.

Treatment.—No internal treatment is indicated in uncomplicated cases. Sufficient nourishment is, of course, important. Locally, cool baths, or bran-baths, afterward drying the skin with fine, soft cloths and carefully avoiding friction, will meet the indications in most cases. Ragged and loose patches of epidermis should be clipped off with scissors, and all denuded and fissured surfaces dusted with finely-powdered calomel. The crusts which accumulate at the angle of the mouth and render nursing difficult and painful are best got rid of by soaking with oil of sweet almonds and carefully removing the loose ones by means of dressing-forceps. Slightly astringent baths (decoction of oak-bark, 1 pint to the bath) are sometimes beneficial.

The most efficacious treatment is the creolin bath: about 15 gallons of comfortably-warm water at 95° F., to which 2½ pints of a 1-per-cent. solution of creolin are added. A bath is taken regularly once a day—in very bad cases twice—remaining in it twenty minutes. It is best given at night, the patient being subsequently dried and put to bed.

Creolin ointment (¼, 1, and 2 per cent., rubbed with lanolin and water in almost equal parts) ranks next to creolin baths in efficacy, especially if used in quite an early stage. Savill (Edinburgh Med. Jour., Apr., '95).

(B) Chronic General Exfoliative Dermatitis.

Definition.—A chronic generalized dermatitis, accompanied by constant exfoliation of the epidermis in dry, papery scales: the pityriasis rubra of Hebra.

Symptoms.—The disease begins with the appearance of red patches, gradually increasing in size, uniting with others until finally the entire surface is a sheet

of red, dry skin. There is no thickness or infiltration. In about a week the epidermis begins to scale off in large, thin, white or grayish scales, which soon become very profuse and shed in large sheets. The skin, at the same time becomes of a dusky- or brownish-red. The inguinal glands also enlarge. Later the skin becomes infiltrated to some extent, and looks tense and shiny in places. The mouth becomes puckered, and the skin of the joints may be fissured and sometimes moist. There may also be boils or pustules, the hair may fall out, and the nails atrophy and exfoliate. There is often fever at the beginning and at intervals during the course of the disease. There is little itching. The subjective symptom mostly complained of is a sensation as if the skin were too small, and the patient frequently is chilly.

The course of the disease is chronic, lasting months or years, with exacerbations of greater severity, alternating with remissions.

There is usually progressive emaciation, and the patient dies of inanition, or is carried off by some intercurrent affection. Happily the disease is rare.

Case of dermatitis exfoliativa in an infant, which appeared on the tenth day of life and gradually (five weeks) spread over the entire body. It was characterized by diffuse redness, more intense in some places than in others, and by foliaceous desquamation. Small vesicles also appeared. The eruption caused itching, but did not interfere with the patient's general condition. There were no lesions in the mouth, and the hair fell in certain spots. Raymond and Barbe (*Le Progrès Méd.*, Jan. 23, '92).

Case of dermatitis exfoliativa in a girl aged 11 years. She was first seized with fever and nausea. Three days later her tongue was heavily coated, the breath offensive, and sores were present. The face, neck, and upper chest presented a

scalded appearance, the epidermis being lifted from the true skin, rolling up like tissue-paper, and being broken in a number of places. The temperature was 103° F.; the pulse 144. The disease pursued its usual fatal course, carrying off the patient two days later. No drug was held accountable for the symptoms. H. M. Beatty (Archives of Ped., Feb., '96).

The cause of chronic general exfoliative dermatitis is not known.

Diagnosis.—The only disease likely to be mistaken for chronic exfoliative dermatitis is scaly eczema. Still, this is never so universally distributed; has usually a history of moisture and exudation at some time in its course; is attended by intense itching and considerable infiltration. Lichen planus is a papular disease, and, while the papules are sometimes aggregated in solid sheets, has a different history from this disease.

Treatment.—The treatment is unsatisfactory. Arsenic, which seems indicated, has little effect on the course of the eruption. Good results are sometimes obtained from codliver-oil, both internally and externally. Saline diuretics and aperients are occasionally beneficial. Externally bland ointments may be applied. The extensive surface involved prohibits the use of mercurial applications, as salivation would be likely to follow. Glycerite of starch or Lassar's paste may at times relieve the uncomfortable sensation of tightness of the skin.

(C) Local Exfoliative Dermatitis.

Definition.—A localized dermatitis of mild character, occurring in rounded or oval spots; rosy, red, or mottled in color, and attended by furfuraceous desquamation. It is the pityriasis rosea of Gilbert and Duhring.

Symptoms.—The most thorough study of the disease in this country is by Duhr-

ing. It begins with the eruption of small macular or maculo-papular lesions, of a rosy or reddish color, sharply defined against the surrounding skin, being sometimes on a level with it, sometimes slightly raised, and sometimes depressed. The patches are covered with fine, branny scales and spread at the margin while healing in the centre. The subjective symptoms are usually slight, only moderate itching being sometimes complained of. The disease lasts from one to three months, recovery taking place spontaneously.

Causation.—It is apparently a vegetable parasitic affection, but no characteristic parasite has been demonstrated in the skin or the scales.

Diagnosis.—The erythematous syphilide most nearly resembles this affection. The history of the case or observation of the patient for a week or two will clear up the diagnosis.

Treatment.—Lassar's paste or other mild salicylic-acid or carbolic-acid ointment may be used. Sulphur is also recommended. As the disease gets well of itself in a short time, not much attention need be given to the treatment.

(D) Epidemic Exfoliative Dermatitis.

This has recently been described by Thomas Savill, of London, who observed a large number of cases in the Paddington Infirmary. The disease begins as an erythematous or papular eruption, spreading peripherally like ringworm. This is followed by exudation and desquamation. The skin is red, thickened, and indurated, the epidermis being shed in flakes or scales. There is moist exudation in most cases, especially in the flexures of the joints or behind the ears. Exfoliation is continuous.

As the disease subsides, the skin becomes brownish, indurated, and thickened, and may be smooth and shiny or

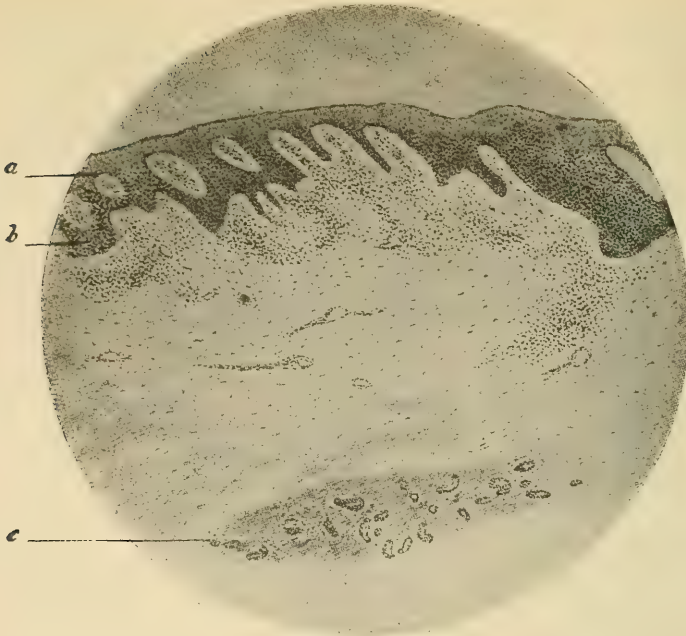


Fig. 1.

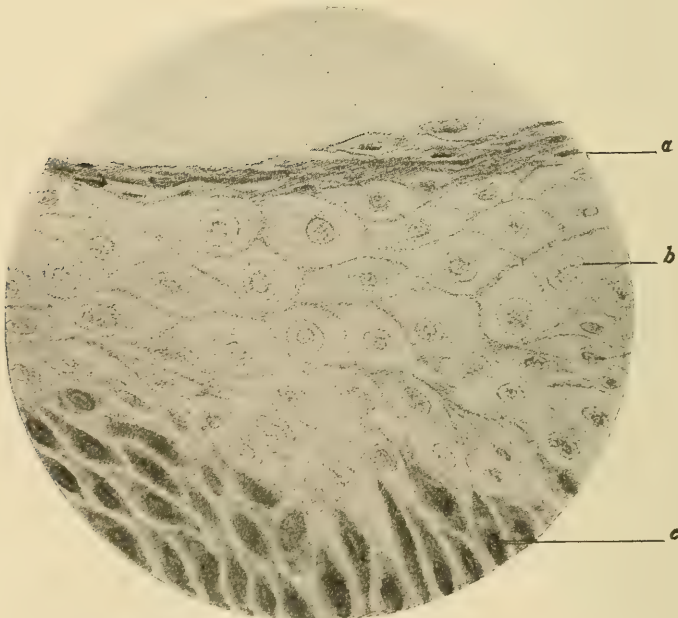


Fig. 2.

Epidemic exfoliative dermatitis: Savill's disease. (*Emilio Echeverria*.)

Fig. 1.—Low power. *a*, Clear superficial layer of epidermis; *b*, darkly-stained, deep layer of epidermis; *c*, periglandular enlargement of coil-glands.

Fig. 2.—Leitz oil immersion, $\frac{1}{16}$. *a*, Horny layer; *b*, middle layer of epidermis, showing peridiaphania of nuclei and swelling of cell-protoplasm; *c*, lowest layer, showing hypertrophied nuclei.

cracked. The hair and nails fall. There is itching and burning, sometimes severe. Albuminuria is frequent (50 per cent. of cases). There may be fever, although this is usually not high. It is most frequent in adults, generally in those of advanced age.

Dermatitis exfoliativa is the only skin malady which, up to the present time, has been connected with epidemic causes. In some respects it resembles eczema. Distinctive points:—

ECZEMA.

1. Attacks all ages, and children are very liable.
2. Gout is a marked predisposing cause.
3. Constitutional disturbance always moderate, and never fatal.
4. Dried crusts thrown off, but exfoliation of cuticle not a marked feature of the disease. Dermal thickening absent or moderate.
5. Course not definite.
6. Not hitherto regarded as contagious or epidemic.

EPIDEMIC EXFOLIATIVE DERMATITIS.

1. Children almost exempt; old people especially prone.
2. Gout offers no predisposition.
3. Constitutional disturbance often severe, and may be fatal.
4. Epidermal exfoliation a constant feature. It may occur in some places without previous eruption. Dermal thickening generally present.
5. Course fairly definite.
6. Undoubtedly contagious and epidemic under certain conditions.

Savill (Edinburgh Med. Jour., Apr., '95).

Prognosis.—This is grave. In Savill's experience over 12 per cent. died.

Etiology.—This is not known, though from its epidemic prevalence, apparent contagiousness, and great fatality it seems to be due to some infectious organism. This has, however, not yet been demonstrated.

Pathology.—A careful histological study of the changes in the skin has been made by Emilio Echeverria (see illustrations), who concludes that the essential histological changes in the disease are superficial and to be found mainly in the epidermis. The cutis is rarely affected to any extent. According to Echeverria, the disease is rather an epidermatitis than a dermatitis. He has found a peculiar diaphanous degeneration of the prickle-cell layer of the epidermis, which he regards as characteristic.

In blastomycetic dermatitis there is a sharply-raised, well-defined, slightly-elevated border, composed of minute verruciform projections, commingled

with small purulent points, from which pus can be expressed. On the side of the sound skin there is a bluish-red, sloping border, with pin-point-sized abscesses, not closely set; while on the morbid side of the inclosing wall is either a moist, granulating surface or a partially-cicatrized reddish and tender disk, with here and there projecting areas made up of the verrucous elevations. The regions of preference are, first, the face; next, the lower limbs; then, in order of frequency, the hand, leg, foot, scrotum, and back. One-half of the cases showed multiplicity of lesions in other parts of the body, suggesting autoinoculability. Evidence favors the view that the medium of infection lodges on the hand or face, and from thence is transferred to some accessible spot. Hyde and Ricketts (Jour. Cutan. and Genito-Urin. Dis., Jan., 1901).

Report of a case. Positive and unquestioned diagnosis between blastomycetic dermatitis and certain forms of cutaneous tuberculosis can scarcely be made without histological and bacteriological investigations. Stelwagon (Amer. Jour. Med. Sci., Feb., 1901).

Treatment.—Savill obtained most benefit from creolin-baths (2 1/2 pints of a 1-per-cent. solution in a bath of 15 gallons of water at 95° F.) or creolin ointment (1/2, 1, and 2 per cent.). The baths should be given once or twice a day.

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DIABETES INSIPIDUS (POLY-URIA).

Definition.—A disease characterized by marked increase in the quantity of urine, without any important qualitative changes in the elements of which it is composed.

Symptoms.—The malady may begin insidiously; but it is not unusual for it to appear suddenly, either following one of the causes which we shall name later

on, or even without any appreciable cause. It may, in exceptional cases, manifest itself during childhood or infancy.

[I have lately had under observation a young man, 16 years old, who was subject to excessive thirst since the first months of his life, the first word he pronounced, at the age of 8 months, being "water." R. LÉPINE.]

When diabetes insipidus is not a primary disease, it may depend upon some nervous affection.

The urine is abundant, usually very pale in color, and is slightly acid. The specific gravity varies from 1002 to 1010. Consequently, the organic and inorganic principles are not present in any great quantity, but, taking into account the daily amount of urine, it will be found that the total quantity of organic and inorganic substances usually considerably exceeds the normal average. With regard to the relative proportions, the chlorides are increased.

In inducing unilateral polyuria in a dog, for instance, by severing a splanchnic nerve, I have likewise observed the relative increase of the chlorides. This fact proves that the relative increase results from an elective permeability of the kidney with regard to these salts.

The quantity of urine voided during the twenty-four hours naturally bears a certain relation to the quantity of liquid ingested. As the cutaneous perspiration is usually greatly diminished in diabetic patients, there is, as a rule, less difference than in the normal state, between the quantity of fluid taken and that of the urine.

It is even possible that, in exceptional cases, the quantity drunk in one day may be less than that of the urine voided during the same time.

In explanation of this paradox there are three hypotheses:—

The first (which is the most natural) is the supposition that during this period the economy becomes impoverished as to water. This hypothesis agrees with several conditions sometimes noticed in polyuric subjects, particularly the increased density of the blood; in this case the weight of the patient should be less during the period in question. The second hypothesis, which, though not based on any special fact, does not seem irrational, premises that there is a much greater formation of water in the economy than in the normal conditions. In this case, there should be a diminution in the respiratory quotient: $\frac{\text{CO}_2}{\text{O}}$. It is evident that, if there is more water formed, there is less CO₂ exhaled. This fact has been observed in certain conditions of infectious fevers.

The third hypothesis appears to be less plausible. It consists in the supposition that the economy may absorb, particularly through the lungs, a certain quantity of watery vapor. It is known that in the healthy subject a copious ingestion of watery fluid is followed, during the two consecutive hours, by the loss, in the urine, of the greater part of the water taken. The same is not the case in diabetes insipidus; the elimination is less rapid, either because the kidney has partially lost its functional elasticity, which enabled it, in the normal state, to free the blood from an excess of water, or rather because the economy, being, relatively speaking, deprived of water, takes up a certain portion of that ingested.

In the same connection it may be noted that in the polyuric subject the difference existing in the healthy person between the urine of the twelve hours of the day and those of the night is not noticeable.

Falck advanced the opinion that ab-

sorption is retarded in polyuric patients. This supposition is, in general, not very likely, but I would say that the dilatation of the stomach sometimes observed in such patients might confirm it in certain cases.

Thirst is a very marked symptom, which, in certain exceptional cases classed under the head of polydipsia, is the original symptom. This point will be again referred to under the head of DIAGNOSIS.

The digestive function is impaired in polyuric patients. This is readily understood, the digestion being disturbed by the ingestion of a large quantity of water, which dilutes the gastric juice. Constipation usually exists.

A phenomenon of some interest, theoretically speaking, has been noticed in some quite exceptional cases, namely: an abnormal flow of saliva. Külz observed this condition for a time in a young hysterical subject, and was able to collect, in one day, more than one pint of saliva.

It is known that physiologists have, during their experiments, sometimes observed salivation in dogs and rabbits, after certain lesions of the medulla oblongata, etc. In some cases the pulse is slow, and there is also a certain relation between this slowness of the pulse and the increase of the polyuria.

The blood is sometimes *more concentrated* than in the normal state, but this is by no means a constant symptom; when it exists it would seem to indicate an exaggerated permeability of the kidneys, and the inability to retain the water of the economy.

The bladder is larger than in the normal state; the kidneys may also be relatively larger, but they do not present any structural alterations.

Although in some cases polyuria unaccompanied with glycosuria is a comparatively harmless affection, yet in others the condition may be a serious one, attended with grave alterations in the general health, and leading in a few years to death. These serious cases of polyuria are believed to depend upon disease of the pancreas. Cases of polyuria run a much more rapid course, and are much more fatal, in children than in grown-up people. Mongour and Gentes (*La Presse Méd.*, Dec. 20, '99).

Diagnosis.—This usually presents very little difficulty. The absence of abnormal principles in the urine indicates by exclusion the existence of simple polyuria. It may happen, however, that the diagnosis between this condition and that of interstitial nephritis gives some little trouble. In certain cases of the last-named affection albuminuria may not exist during a certain period. On the other hand, there are cases of polyuria in which, without any actual nephritis, traces of albumin may be found in the urine.

However, when interstitial nephritis exists, certain uræmic symptoms, hypertrophy of the heart or some one of the symptoms of Bright's disease, are always present. Besides searching for the symptoms of uræmia (cephalalgia, dyspnoea, etc.), it should also be remembered that a patient suffering from Bright's disease eliminates less nitrogen in his urine than polyuric patients, and that the urine frequently contains casts. In view of these characteristics, it is generally easy to establish a diagnosis.

Polyuria presents several varieties: primary polyuria and primary polydipsia. How are these to be distinguished?

In polydipsia thirst is unquestionably the first symptom; it is not preceded by frequent micturition. Polyuric patients do not perspire; in polydipsia perspiration is likely to occur. In the latter

affection the quantity of urine does not amount to the quantity of liquid ingested; so that, if the patient refrain from drinking during several hours, there will be, during this time, a diminution or even an arrest of the excretion of the urine.

Finally, in the polydipsic patient the blood is more rich in water, while in the polyuric it is more concentrated.

Polyuria, frequently spoken of as diabetes insipidus, should, in many cases, be referred, not to its connection with the renal function, but to polydipsia, to which it is, of necessity, a secondary phenomenon. The diagnosis of these cases of primary polydipsia rest largely upon the following points: The existence of perspiration in spite of the polyuria, the disappearance of the polyuria after enforced abstinence from water, the fact that the amount of urine voided does not represent the entire amount of water ingested, and the fact that micturition is apparently dependent in time upon the drinking of water. Westphal (*Berliner klin. Woch.*, Sept. 2, '89).

Etiology.—Diabetes occurs most frequently in middle age, but polyuria is not rare in childhood. In some families several polyurics will be found; these are usually families showing a neuropathic diathesis.

Case observed in a girl, 16 years old, who suffered from diabetes insipidus, who belonged to a family in which the disease was hereditary. Four generations and 8 out of 19 members of the family had suffered from polyuria, viz.: the great-grandmother, 3 of her children, 3 grandchildren, and the great-grandchild,—the patient. The disease was, in all cases, directly inherited by the child from its parent, all the first-born being attacked. The great-grandfather suffered from enuresis, but not from polyuria. Lauritzen (*Hospitalstidende*, p. 353, '93).

Study in metabolism on two cases of diabetes insipidus in a man of 47 and

a girl of 14 years showed that they did not eliminate more water in the urine than they ingested; insensible perspiration was practically normal, contrary to the statements of some. In one case there was a retention of the albumin metabolism and in the other a loss. Digestive functions were good. Acidity of the urine was high. The elimination of P_2O_5 in the fæces was normal. In the urine there was a retention on the part of the man and a loss of P_2O_5 on that of the girl. G. Vannini (*Berliner klin. Woch.*, July 16, 1900).

In a certain number of cases the polyuria is referable to a traumatic cause; for instance, a fall upon the head. Sometimes diabetes mellitus immediately follows the traumatism and it is only after a time, two months or more, that it changes to diabetes insipidus. There is, consequently, an undoubted connection between the two affections. This has likewise been proved by experimentation. Claude Bernard, in puncturing a certain spot in the floor of the fourth ventricle in a rabbit, caused diabetes mellitus, while in puncturing at a slightly different point, he caused simple polyuria.

After traumatism of the cranium the chronic lesions of the encephalon, and tumors, in particular, occupy an important place in the etiology of polyuria. I have seen several cases of this kind. In one of them there was found at the autopsy a tumor of the optic thalamus. The polyuria appeared very suddenly.

Syphilitic lesions of the encephalon are the principal causes of polyuria. The number of such cases is very great.

Finally, simple neuroses frequently bear a relation to this affection.

As already pointed out by the writer, the suprarenal gland contains a substance which gives rise to glycosuria if brought into the circulation in minute doses. This substance is identical with

that constituent of the suprarenal which turns solutions of iron green and reduces ammoniacal solution of silver, and which also serves to increase blood-pressure. Suprarenin and adrenalin possess this sugar-producing power. A fraction of a milligramme of this substance, or the contents of a single suprarenal gland, serves to give rise in a rabbit to nearly 6 per cent. of dextrose in the urine. In dogs fed exclusively on meat, 4 per cent. of grape-sugar was found in the urine. The glycosuria persisted for two and three days. By continued injections of suprarenal juice true diabetes may be produced. The starting-point of the sugar-producing agent of the suprarenals the writer believes to be in the liver. Hungry dogs whose glycosuric power may be regarded as exhausted excrete scarcely any dextrose after injections, but if fed on fat they begin again to give off dextrose in large quantity. There is a great probability that the suprarenals have etiological relation to many forms of human diabetes; especially Addison's disease may be due to loss of activity in the suprarenals. F. Blum (*Amer. Medicine*, May 31, 1902).

Pathology.—As to the pathogenesis, it is not unlikely that primary polyuria—not polydipsia—is caused by paralysis of the vasoconstrictors of the kidney. It is difficult to conceive of a permanent excitation of the vasodilators. There may likewise be a defect in the normal resorption of the water, which, as we know, takes place in the normal condition in the tubules; but this mechanism appears rather to be that of the polyuria attending interstitial nephritis. The health is naturally much less affected in polyuria than in diabetes mellitus; but in true polyuria the defective hydration of the tissues is likely to cause certain nervous troubles, which in themselves are of no very great importance.

Treatment.—In neuropathic subjects the general condition should be treated

by means of bromide of potassium, valerian, etc. For the special treatment of the polyuria ergot of rye (or, even better, ergotine) and antipyrine should be used.

The above two remedies, the first-named, in particular, have cured the disease. I have also obtained some success by the use of the continuous current, the positive pole being placed upon the spinal column, and the negative at the level of the hilum of the kidney.

Small doses of amylene hydrate may in many cases bring about a temporary improvement in the polyuria and polydipsia and, in a few, a permanent cure. The only drawbacks are the disagreeable taste and insolubility. It can be ordered in capsules to be followed by a glass of beer or wine. W. Niessen (*Ther. Monats.*, Aug., 1900).

If the polyuria is dependent upon nervous lesions, the same means are to be employed.

R. LÉPINE,
Lyons.

DIABETES MELLITUS.

Definition.—A malady characterized by non-accidental—that is to say, a permanent or very nearly permanent—glycosuria.

Symptoms.—With but rare exceptions, the onset of this disease is insidious, and cannot be recognized by the patient. Many cases of diabetes remain entirely unsuspected until the time when some symptom other than the glycosuria attracts the attention of the patient. This may be either excessive thirst, polyuria, unusual weakness, or even impotence. More rarely, it is a sudden diminution of the acuity of the vision, or perhaps a complication in the form of anthrax or balanitis in men, and pruritus vulvæ in women. The daily quantity of urine is increased, except in some

rare cases, classed under the head of "*diabetes decipiens*."

Initial symptoms of diabetes mellitus in children are apt to be incontinence of urine, nervous irritability, and great thirst. Strength, flesh, and color may sometimes be retained until nearly the end. A gain of weight and height, even, may occur, without any amelioration of the disease. Townsend (Boston Med. and Surg. Jour., May 11, '99).

Pruritus vulvæ is the initial symptom of diabetes in about 20 per cent. of the cases. Premature menopause is relatively common in diabetics. Danckworth (Centralb. f. Gynäk., No. 23, '99).

In 350 cases 219 complained solely of polydipsia as the first sign of diabetes. Lassitude, neuralgia, insomnia, neurasthenia, and syncope were, in the order named, the principal symptoms. M. E. Dufourt (La Presse Méd., June 2, 1900).

The urine is pale in color, the reaction is sometimes unmistakably acid; the specific gravity, except in some very rare cases, is very perceptibly increased (1025 to 1045 and even 1050 has been met with). The odor is sweet, owing to the presence of glucose, which may amount to, or even exceed, 8 per cent. Generally speaking, the quantity as given by Fehling's test is a little more than that registered by the polarimeter. This is due, first, to the fact that the urine contains reducing substances which are not deviated by polarized light, and, second, to the fact that in a number of cases of severe diabetes beta-oxybutyric-acid salts are present in the urine, which deviate to the left in such a manner that a portion of the deviation of the glucose to the right is thus masked.

In mild cases of diabetes the true beta-oxybutyric acid is not present in the urine; there may, however, be other substances which deviate to the left, especially levulose, which has occasionally been met with in diabetes, to the

exclusion of the glucose (Zimmer, Külz, Seegen, Marie).

Other sugars have sometimes been found; for instance, traces of pentose (Salkowski, Külz), inosite, etc.

A mixture of dextrosazone and pentosazone found in the urine of 76 out of 80 cases of diabetes. In 64 reaction positive, in remaining 12 cases doubtful. Külz and Vogel (Zeit. f. Biol., B. 32, p. 185, '95).

In 12 cases of diabetes the excretion of calcium salts was considerably increased in the severe forms of diabetes, while in mild forms the excretion was the same, or only a little in excess of that met with in the urine of healthy persons. This increased lime excretion is due to the greater amount of food and water taken, especially to the increased amount of nitrogenous food. In those cases in which very large quantities of lime salts are excreted (1 to 1½ grains of calcium oxide) in the twenty-four hours, the destruction of the albumin of the body is playing some part in the production of this condition. E. Tenbaum (Zeit. f. Biol., pp. 379-403, '96).

Several important chemical substances are found in diabetic urine. Next to sugar, those having the greatest significance are acetone, diacetic acid, and oxybutyric acid. E. L. Munson (Jour. Amer. Med. Assoc., May 1 to 22, June 1, '97).

Albuminuria exists in diabetes, in at least one-third of the cases, but in only a few cases is it symptomatic of Bright's disease.

One of the most common complications of diabetes mellitus is an albuminuria, doubtless in most instances secondary to the action of a urine rendered irritant by the presence of sugar upon the renal structures. In 1300 diabetics in whose urine the condition was sought for, 824 were also subjects of an albuminuria. In a large number of these cases the cause of the albuminuria is probably the excessive amount of eggs consumed in the diabetic diet, while in others the albuminuria is symptomatic of some complication, as tuberculosis, cardiac

disease, renal inflammation, or a cystitis or pyelitis, depending upon the irritating nature of the sugary urine. Schmitz (Berliner klin. Woch., Apr. 13, '91).

In pancreatic diabetes albuminuria is quite exceptional; in traumatic diabetes it is a little more frequent; albuminuria is by far most frequently met with in diabetes with obesity. In grave form of albuminuria of diabetes well-marked nephritis is always found at autopsy; in the benign form but slight nephritic changes are sometimes found; more rarely no changes are detected in the kidneys. Replacement of sugar by albumin is always an extremely grave sign, but the case may not immediately terminate fatally. Jacobson (Gaz. des Hôp., Aug. 25, '94).

The frequency of albuminuria in diabetes is variable and may occur in two forms: functional and that due to grave nephritic disease. In the first form it may be extremely slight, or else may constitute a very marked feature in the case. Goudart (Jour. de Méd., Aug. 25, '97).

Owing to the polyuria, urea is naturally only present in the urine in a very small proportion, but the daily quantity of this substance is increased. Its relation to the total of nitrogen is not noticeably altered, except in grave cases of diabetes, in which the proportion of ammoniacal salts is, as is well known, greatly increased, in order to overcome the acid dyscrasia.

In serious cases the excretion of lime is also increased. Thirst is usually, but not always, predominant. Hunger is much less frequent, and a great many diabetic patients do not eat any more than a healthy person. Constipation is the rule, being either due solely to the impoverishment of the system with regard to water, or to an exaggerated tonus of the splanchnic nerve. It may be stated, in support of the latter hypothesis, that this symptom frequently precedes the appearance of the diabetes.

The saliva is more abundant. Exceptionally it has been found to contain sugar and sometimes lactic acid. The skin is dry and perspiration is rarely modified from the normal. The blood contains a variable proportion of glucose, usually more than 3 grammes per litre, and quite frequently from 4 to 5 grammes. In exceptional cases, when the kidneys have undergone alteration, the proportion may be greater.

[I have recently seen a case in which there were more than 10 grammes of sugar per litre. R. LÉPINE.]

There is no close relation between the percentage of sugar in the blood and urine. That more sugar is excreted by the urine on certain days than on others does not depend on the fact that the amount in the blood has reached a certain quantity, but on other complex conditions. The administration of a diuretic diminishes hyperglycæmia and retards the decrease of glycosuria. Lépine (Lyon Méd., July 21, '95).

When treated by certain aniline colors, the red globules (as found by Bremer) take on a different color in diabetic patients from that assumed in other patients or in healthy subjects.

The pulse is full, but of normal frequency, except in the case of complications, when it may be rapid.

The majority of diabetics excrete more nitrogen than healthy persons of the same weight. This results from the fact that the sugar not being completely utilized, they must necessarily consume more albuminoid matter (and fatty substances), as has been proved by comparative experiments made upon a diabetic patient and a healthy subject.

[Pettenkofer and Voit formerly believed that diabetics absorbed less oxygen and excreted less carbonic acid than healthy subjects. Later on Voit formulated certain reservations upon this subject, and Leo, in an important article, affirmed that, with an equal weight in

the diabetic and the healthy person, the respiratory exchanges are the same. This opinion has again been contradicted. R. LÉPINE.]

Twenty experiments upon 5 diabetics, two having a grave form of the disease, which prove that the absorption of oxygen and the exhalation of carbonic acid are not diminished in diabetics, if their weight is considered. The following are the figures obtained by causing the patients to breathe for several minutes into the apparatus of Zuntz and Goppert, the volume of gas being calculated by minutes and the kilogrammes by weight:—

	CO ₂ .	O.	Quotient.
First patient (grave), . .	3.21	4.01	80.0
Second patient (mild), . .	2.88	3.87	74.4
Third patient (mild), . .	3.21	2.84	81.0
Fourth patient (mild), . .	2.80	3.48	80.0
Fifth patient (very grave), .	2.84	4.27	66.5

Hans Leo (Zeit. f. klin. Med., B. 19, '92).

Hanriot, Weintraub and Laver, Ebstein, and others positively assert that, when subjected to the same *régime* diabetics exhale less carbonic acid than healthy persons.

The diminished CO₂ is the result, not the cause, of the diabetic condition; there is less CO₂ because there is less combustion of glycogen. Arnold Cantani (Deut. med. Woch., Nos. 12 to 14, '89).

The diminished elimination of CO₂, which is characteristic of diabetes, is the cause of the large sugar production, because in health the action of the diastatic ferment upon glycogen is held in check by CO₂. Ebstein (Annual, '90).

When a diabetic subject has been made to absorb a large proportion of starchy matter or sugar, the difference in the respiratory exchange between the diabetic and the healthy subject becomes particularly evident. The healthy person, soon after this ingestion, exhales a large amount of carbonic acid; in the diabetic there are no very noticeable modifications. This important fact, added to many others, proves that the diabetic is incapable of utilizing the

carbohydrates as effectively as a healthy subject.

Views based upon experience with 1004 cases. In diabetes mellitus we have a non-combustion of carbohydrates, whether introduced from without or produced within the organism. The fact that the ingestion of sugar is always followed by its appearance in the urine at a very short interval disposes of all theories which make diabetes the result of increased sugar-production in the tissues. Diabetes consists, in the first place, in the non-combustion of some part of the carbohydrates, the excess of non-assimilated sugar appearing in the urine. As the disease progresses, a smaller and smaller amount is burned, until none is oxidized. Arnold Cantani (Deut. med. Woch., Nos. 12 to 14, '89).

Nearly all cases of diabetes show fluctuations in the twenty-four hours. Generally diabetics cannot assimilate the carbohydrates which are taken for breakfast on an empty stomach, but they may assimilate these substances if taken for luncheon or dinner. There is prognostic value in the fluctuations which occur in the elimination of sugar; if these are regular, they indicate a mild case; if they are not marked and are irregular, the case is relatively severe. F. Frederick Crouse, Jr. (Albany Med. Annals, Aug., '99).

GENERAL SYMPTOMATOLOGY.—I shall successively take up (1) those of the nervous system, (2) those of the vascular system, (3) those of the respiratory tract, (4) the digestive apparatus, (5) the urinary tract, and (6) the skin and the locomotor apparatus, ending with a summary statement concerning the diabetic coma.

Nervous System.—The most common secondary nervous lesions of diabetes are certain peripheral neuroses, especially those which cause the abolition of the knee-jerk.

Eighty-nine out of 210 diabetics, or a little more than 43 per cent., presented either a total loss or a notable depression

of the tendon-reflex. Nivière (Jour. de Méd. et de Chir. Prat., June, '89).

The condition of the knee-jerk tested in 184 cases of diabetes mellitus. As only 1 examination was made in 56 of the cases, they are excluded from consideration. Of the 128 remaining cases, the knee-jerk was normal in 113 and increased in 2. In the latter cases the patients were suffering from a severe form of diabetes. In 4 cases of severe diabetes the knee-jerk was absent or greatly diminished. The phenomenon was absent in 9 slight cases. Excluding 3 of these,—because 2 of the patients were tabetic and the third was too obese to admit of satisfactory examination,—there were only 10 patients (7.6 per cent.) in whom the knee-jerk was abolished or much reduced. Grube (Bull. de la Soc. Anat., Nov. 15, '93).

Analysis of 50 cases of diabetes with relation to the knee-jerks. They were both absent in 50 per cent., both present in 38 per cent., and feeble or one absent in 12 per cent. In patients under 25 years the knee-jerks were absent in 80 per cent.; under 30 years, absent in 75 per cent.; over 30 years, absent in 46 per cent. R. T. Williamson (Med. Chronicle, No. 2, '93).

The loss of the knee-jerk is due to a neuritis, which also underlies the neuralgias and various peripheral nervous phenomena. This neuritis is to be met with very much more frequently in the lower extremities than in the upper; it is generally bilateral, but may be one-sided. Auché (Lancet, Aug. 8, '91).

Three hundred and thirty-two cases of diabetes mellitus in which the knee-jerk was tested. The knee-jerk was lost in 49 per cent. of the cases of slight diabetes and but 24 per cent. of the severe cases. In 11 cases there was neuritis on both sides, no cause but diabetes being present, except possibly alcohol in 2 cases. Three manifestations of nervous disturbance were caused by increase of sugar in the blood: (1) cramps, or an acute irritation of nerves; (2) neuritis, or acute inflammation of the nerves; (3) a slow degeneration, or nutritive change, in the nerves, seeming to have a preference for the crural nerve, and thus causing loss

of knee-jerk. Grube (Lancet, July 22, '99).

The other neurotic symptoms are pain and, more rarely, paralysis. It has been known for a long time that the neuralgia of diabetes is very painful and difficult to cure. Worms has noted that it is very often symmetrical, and states that the pain increases and decreases with the hyperglycæmia, which is certainly inconstant. Ziemssen was the first to refer this neuralgia to a neuritis. There are also shooting pains that somewhat resemble those of ataxia, and which may, in some cases, suggest the question as to whether there is not actual tabes: a very difficult problem to decide.

The relation existing between tabes and diabetes may vary in character; diabetes being present, certain symptoms of tabes may occur (*pseudotabes diabétique*); or during the course of tabes sugar may appear in the urine (tabes with glycosuria). There is, besides, relation between true tabes and true diabetes, through the fact that these diseases occur in various persons of the same family, in consequence of an hereditary nervous taint, both appearing at times in the same subject. Bloq (Revue Neurol., Apr. 30, '94).

Vergely reported a case in which there were pains resembling those of angina pectoris.

The *paralyses* of diabetes present themselves as follows: 1. Limited and incomplete paralysis; this is, by far, the most prevalent form, as has been stated by Bernard and Féré in 1884. 2. Monoplegia. 3. Hemiplegia. 4. Paraplegia. The various forms of diabetic paralysis are sometimes associated, or are combined, with some unusual phenomena; for instance, facial hemiplegia preceded by facial neuralgia and a falling of the upper eyelid (Charcot, quoted by Bernard and Féré), or paresis of the extensors of the left thigh, impeded speech,

and deviation of the mouth to the left (Charcot, *ibid.*), etc. The progress of these paralyses is also somewhat peculiar: they are sometimes migratory and transitory. Some of them are undoubtedly of central origin, but the majority are of peripheral origin, a neuritis forming their anatomical substratum. The peripheral variety is not exempt from this rule, as is proved by the existence, in diabetic paraplegia, of the symptom-complex which Charcot has given the name of *steppage*, which is characterized by the lowering of the forward part of the foot in walking. This we know is due to the paralysis of the extensors of the foot, and it occurs in peripheral neuritis, but not in myelitis.

Cramps are another motor disturbance met with in diabetic subjects. These occur principally in the lower extremities, and at night they give rise to insomnia, which, according to Bernard and Féré, appears to be, in diabetic subjects, the first symptom of disturbance of the cerebral circulation, and may sometimes prove to be the forerunner of serious symptoms.

Frequency of cramps in the calves in diabetics. Disease frequently begins in form of an obstinate gastric catarrh; examination of urine for sugar in all patients suffering from rebellious catarrh of stomach, recurring in spite of all treatment, desirable. Jacobson (Brooklyn Med. Jour., Nov., '94).

[Convulsions are rare. Some time ago I reported a case in which they, as well as aphasia and hemiplegia, depended upon microscopical cortical lesions. R. LÉPINE.]

The complication of aphasia may occur in either pronounced or latent cases of diabetes, and may be associated with obstinate neuralgia, disturbance of vision, headache, or impairment of hearing. The aphasia may occur at any period in the course of the disease, and may last from a few hours to a month or more.

The prognosis is always good. The condition can be said to resemble very closely the various forms of toxic aphasia that attend uræmia, pneumonia, gout, and tobacco-poisoning. Corneille (Gaz. Hebd. de Méd. et de Chir., Jan. 20, '98).

Perforating ulcer sometimes complicates diabetes. Folet and Auché have observed the falling off of the nails. In Folet's case they fell without giving rise to pain or inflammation.

Case of diabetes in an infant 4 to 5 months old. The urine contained large quantities of sugar. Polyuria, polyphagia, autophagia, and boils were present. At autopsy there was found acute broncho-pneumonia with pulmonary œdema, acute intestinal catarrh, œdema of the dura, and a serous effusion in the third ventricle. N. A. Orlov (Vratch, Mar. 3, 1901).

Organs of Special Sense.—Cataract is the most common symptom; it nearly always develops in both eyes; if not simultaneously, at least after a short interval. It is characteristic of this form of cataract to be relatively soft. Retinitis is next in order, with white exudations along the vessels and in the perimacular region.

Many causes may lead to ocular lesions in this disease. Among them are (1) diminution of water; (2) diminution of resistance of the vessels, due to general weakening of nutrition; (3) the existence of a toxic substance in the blood, produced by abnormal processes; (4) various complications. Mauthner (Inter. klin. Rund., No. 25, '93).

From a study of 25 cases in which lesions of various character were found in association with diabetes, three groups are distinguished: (1) a characteristic inflammation of the central region of the retina, with small, bright areas, and frequently, also, small hæmorrhages; (2) retinal hæmorrhages, with the consequent inflammatory and degenerative changes; (3) rarer varieties of retinitis and degeneration, the relation of which to the constitutional disease remains to

be demonstrated. Hirschberg (Deut. med. Woch., Dec. 18, 25, '90).

This form is nearly always accompanied by slight hæmorrhages. True optic neuritis is much more rare.

The retinitis of diabetes distinguished from that of Bright's disease as follows: 1. The patches are irregularly distributed around the centre of the retina, not specially near the macula, and are met with on the nasal as well as on the temporal side of the disk. 2. The patches are never arranged in a fan shape. 3. They are never associated with papillitis or diffuse retinitis. 4. The hæmorrhages are, as a rule, punctiform, and not striated. 5. Hæmorrhages into the vitreous are common. Saundby (Birmingham Med. Rev., Jan., Feb., '93).

Out of 140 diabetics, 34 were found who were the subjects of retrobulbar neuritis, which could not be attributed to abuse of alcohol or tobacco. Schmidt-Rimpler (Annal. d'Oculist., Sept., '96).

Unusual case of neuroretinitis where the changes were very characteristic of albuminuric retinitis, with two exceptions, namely: the star-shaped figure that is commonly seen at the macula in albuminuric retinitis was found below and to the nasal side of the disk, and the papilla was swelled more than is usually found in the albuminuric form. The round, white patches, the numerous small and flame-shaped hæmorrhages, and the œdema were found. Lens and vitreous were clear. Vision equaled $\frac{20}{70}$. The man complained only of decreasing vision.

The urine was repeatedly examined, but showed no trace of albumin or sugar. It was abnormally abundant, very rich in phosphates, and of normal specific gravity. At first he passed seventy-nine ounces daily. Hansell (Phila. Poly-clinic, Jan. 30, '97).

This condition would explain the existence of the central scotoma sometimes met with in diabetes.

Case of diabetic neuritis with central scotoma. At autopsy zone of degeneration in optic nerve. Fraser and Bruce (Edinburgh Med. Jour., May, '95).

Besides the ocular lesions mentioned, Panas, and, after him, Hirschberg, have insisted upon visual disturbances caused by a defect of accommodation.

Out of 7176 eye-patients, 113, or $1\frac{1}{2}$ per cent., were diabetics. After ten years' existence this disease regularly causes alterations of the eye-structures, particularly of the lens and retina. In a third of the cases diabetes was found associated with some of the following significant changes: (1) uncomplicated paralysis of accommodation in middle life; (2) late myopia occurring between 40 and 60 years, without changes in the lens; (3) retinitis; and (4) quickly developed cataract in young persons in poor health. Hirschberg (Deut. med. Woch., Mar. 26, '91).

A diminution in the amplitude of accommodation seen in five diabetic subjects is dependent upon a general muscular weakness affecting more particularly the internal rectus muscles Mauthner (La France Méd. et Paris Méd., Dec., '93).

Paralysis of the intrinsic muscles is very rare. Paresis of the abducens sometimes occurs; also a combined paralysis of the motor oculi, which gives rise to imperfect lateral motion of both eyes. A nuclear origin is evident in these cases.

Gellé states that suppuration of the ear is not rare in diabetics. The progress of acute otitis is the same as that observed in gout: rapid tumefaction, protrusion, and redness of the tympanum. During the second day severe pain, and afterward abundant suppuration.

Case of otitis media diabetica due to micro-organisms, diabetes having lowered vitality of tissues. Primary in tympanic cavity and secondarily a mastoiditis. In mastoid disease urine should always be examined for sugar. Davidsohn (Berliner klin. Woch., Dec. 17, '94).

Inflammation of the mastoid is very frequent in diabetes mellitus. R. A. Urquhart (Med. News, Mar. 21, '96).

Two cases of acute mastoiditis in per-

sons suffering from diabetes mellitus. In the first case, the patient, a woman aged 50, induced the acute ear inflammation as the result of snuffing salt-water up the nose. At first she made good progress under treatment. Soon, however, began to complain of considerable pain in the right half of the head, with continued discharge, renewed pulsating tinnitus, and commencing mastoid tenderness, until it became requisite to open the mastoid process. The interior of the process was found made up of small cells, in many of which were unhealthy granulations.

In the second case, the patient, a man aged 58, had suffered from diabetes for about one year. The attack of middle-ear inflammation was induced as the result of influenza, and was soon complicated by mastoid involvement. When opened, extensive bone disease was found present. J. E. Sheppard (*Med. News*, May 2, '96).

Bouchardat dwells upon the diminution of the memory and the existence of a growing indifference; the loss of aptitude for any intellectual work, a tendency to anger, melancholy, and hypochondria. It appears to me that this author has laid the colors on rather heavily in painting his picture; mental symptoms are not usually met with in diabetic subjects independently of the many cases in which heredity plays an important part.

Sugar in the urine is not at all common among the insane. Forty cases observed who had diabetic relations, 10 of them having diabetic parents or grandparents, 14 having diabetic brothers or sisters, 12 having aunts or uncles and 3 cousins suffering from this disease. Besides these there were 12 insane patients who had insane and diabetic relatives and 10 patients who were both insane and diabetic. Nearly all the cases of insane diabetics were affected with melancholia. The patients who had been diabetic and had then become insane had almost all lost some or all of the symptoms of the diabetes during the

period of their insanity. Mallet (*Bull. de la Soc. Anat.*, Nov., '90).

Diabetes is a disease which often shows itself in families in which insanity prevails; the two diseases are certainly found to run side by side, or alternately with one another, more often than can be accounted for by accidental coincidence or sequence. Maudsley ("*Pathology of Mind*," p. 113, '79).

The psychoses which develop in the course of diabetes usually take the form of melancholia. It is rarely that maniacal excitement is observed, circular insanity being oftener seen. Finder (*Inaugural Dissertation*, '92).

Three cases of diabetes seen complicated with mental disturbances. In the first case there was melancholic depression with suicidal ideas; in the second, mental debility; and in the third considerable pruritus vulvæ with general uneasiness. In all three cases there were no hereditary influences. S. Ierzykowski (*Nowiny Lekarske*, July, Aug., '93).

Investigation carried on at the Banstead Asylum and extending over a period of eighteen months. Between the 11th of January, 1894, and the 25th of June, 1895, there were (excluding transfers) 268 males admitted to the asylum; and in 175 of these an examination of the urine was made within forty-eight hours after admission. In 12 instances, or in 6.85 per cent. of these 175 cases, sugar was almost certainly proved to be present. The following table indicates the varieties of mental disease under which these admissions labored, and the distribution among them of the 12 examples of glycosuria:—

Congenital Cases...	2	
Epileptic Insanity...	18	
General Paralysis...	30	3
Mania	43	
Melancholia	55	6
Delusional Insanity...	5	
Organic Dementia...	6	2
Senile Insanity.....	16	1
Totals	175	12

C. Hubert Bond (*Jour. of Mental Science*, Jan., '96).

However, when, as has been remarked by Bernard and Féré, an improvement in the mental condition occurs during the antidiabetic treatment, one would be inclined to admit a certain relation between mental symptoms and the diabetic dyscrasia. The same conclusion is reached when the glycosuria and manic symptoms alternate. Cases of this kind have been reported.

Vascular System.—The lesions of the heart have been indifferently studied until of late. Among 380 diabetics Mayer has observed cardiac complications in 82.

Of 380 cases, 337 were in the first stage of diabetes and 47 in the second stage; of the latter 26 were under observation during both stages. Increased cardiac volume, either from hypertrophy or dilatation, is much more frequent in diabetes than one would suppose from the literature, it being found without other anatomical lesions in 82 of the 380 cases. J. Mayer (Zeit. f. klin. Med., B. 14, H. 3, '88).

These patients are either of very delicate constitutions, with the heart weak and irregular, or they are obese diabetics, with the face red or cyanosed, who present a strong cardiac impulse, and signs of dilatation of the heart, either with or without atrophy. These patients are liable to die suddenly. Such cases should not be confounded with the true diabetic coma; moreover, they differ from the latter by the absence of acetoneuria and by the suddenness of death. Very often it is after a voyage or fatigue of some kind that these patients fall into a state of collapse, with cold extremities; small, feeble pulse; a loss of consciousness, more or less rapid; and death in a few hours.

Five cases of diabetic angina pectoris; in one sudden death during attack. Vergely (Jour. de Méd. de Bordeaux, '94).

There are also mixed cases, where, with a weak heart, there is, at the same time, autointoxication. I have myself observed three such cases. The anatomical examination of the heart shows the myocardium rather atrophied and pale.

In Virchow's necropsy the heart was enlarged in nine cases out of sixty-nine, and exclusive of those in which there was enlargement from anatomical causes (vascular, valvular, or renal disease), a percentage of 13. Mayer (Zeit. f. klin. Med., B. 14, H. 3, '88).

Of the patients who died of diabetes at the Berlin Charité 10 per cent. had cardiac enlargements without valvular or arterial lesions or renal disease. O. Israel (Annual, '89).

Arteriosclerosis is exceedingly common in diabetics. Ferraro dwells particularly upon generalized endarteritis. According to him, the atrophic and necrotic lesions reported in various organs are due to this endarteritis.

In the last 11 years there have been 26 cases of diabetic gangrene admitted to the wards of St. Thomas's Hospital. From a study of these cases the following conclusions may be noted: 1. That it yet remains to be proved that true gangrene (excluding death from acute specific processes, which may occur in any subjects and at any age) occurs in diabetic patients unaccompanied by such arterial disease as would of itself produce the gangrene. 2. That the glycosuria may or may not precede the gangrene, but is not usually accompanied by other signs of diabetes. 3. That septic wounds may produce a glycosuria, which vanishes when the septic process is removed. 4. That individuals suffering from septic processes are often on the border-land of glycosuria. 5. That gangrene may aggravate a pre-existing glycosuria. 6. That the arterial disease is sometimes that which accompanies, or is produced by, chronic renal disease. 7. That it has yet to be proved that neuritis can produce any gangrene comparable to that of the so-called diabetic gangrene. 8. That the best chance of recovery is offered

by removal of the limb near the trunk, and that this measure should be undertaken before the patient is reduced by septic absorption. 9. That the presence of glycosuria may be an indication, instead of a contra-indication, for operation. C. S. Wallace (Lancet, Dec. 23, '99).

Edema, which is quite common in diabetes, is not always symptomatic of an affection of the heart. It may possibly be due to a complication of Bright's disease of the kidneys, but this is extremely rare; to a venous thrombosis, of which examples have been reported by Pavy, Gull, Dionis des Carrières, Leudet, Potain, and others. Sometimes there appear to be active tumefaction and other inflammatory phenomena that are apparently due to vasomotor disturbances. In many cases the oedema depends upon the impaired nutrition of the vessels caused by the dyscrasia.

Pulmonary Apparatus.—The most frequent complication in this direction is pulmonary phthisis. At least one-third of the cases of diabetes treated in the hospitals are on account of this. The lesions of diabetic phthisis are almost always those of bacillary tuberculosis. The exceptions met with are cavities following pulmonary gangrene, which, as has been remarked by some clinicians, have not the usual foetidness. There are also ulcerations due to a fibrous ulcerative pneumonia (Marchand). Dreschfeld, Fink, and others have reported similar cases. After phthisis, pneumonia is a serious complication of diabetes.

Pneumonia is rare in diabetes. In 700 cases of diabetes only 7 cases of pneumonia observed, not counting 1 case of broncho-pneumonia and 5 of influenza-pneumonia. In none of these cases did the sugar disappear during the febrile period. The prognosis is always unfavor-

able. Bussenius (Berliner klin. Woch., No. 14, '96).

Diabetics are so prone to bacterial invasions because the glucose has a favorable effect on bacterial growth, the sugar lowers the resistance of the tissues, and the diabetic cachexia and the lessened alkalinity of the blood assist. As result of examinations in twenty-nine cases it was found that the most frequent complication was tuberculosis (41 per cent.). Honl (Wiener klin. Rund., No. 16, '98).

It may begin like ordinary pneumonia. I have seen several such cases. The temperature does not differ from that usual in pneumonia, and the urine remains, notwithstanding the fever, at its usual ratio. There are also cases of rapid pneumonia, of which I have observed several. In the primary congestive period death may ensue in a few hours. Pneumonia is principally met with in diabetics presenting intense glycosuria.

Digestive Apparatus.—The gums are usually red and tumefied. Dental alveolo-periostitis exists, as a rule, when the diabetes dates back several years. The teeth soon become loose in the alveoli and fall out, and dental caries frequently exists. In arthritic diabetes pharyngitis is often present, or, at all events, congestion of the pharynx, with the expectoration of sanguineous mucus.

Form of pharyngitis symptomatic of diabetes or albuminuria observed. There is at first a slight difficulty in deglutition, a sensation of pressure in the throat, and a deposit of mucus which annoys the patient considerably. An examination of the throat shows the pillar of the fauces and the posterior portion of the pharynx to be reddened, the mucous membrane red, swelled, and frequently covered by a layer of glairy mucus. Garel (Universal Med. Journal, Dec., '94).

Laryngeal vertigo may also occur, but this symptom belongs rather to the arthritis than to the diabetes.

Diabetic ulceration of the throat noted in five cases. Ulcers have a tendency to increase in depth and extent, and are extremely painful. These ulcerations occurring in diabetics do not present any characteristic appearance or location. W. Freudenthal (Laryngoscope, Feb., 1900).

The stomach is dilated in all cases of polyphagic diabetes. In the latter cases the digestion is *apparently* accomplished much more readily than one would suppose, in view of the enormous quantity of food taken, but this is often only apparently the case, as, notwithstanding the absence of symptoms of indigestion, the food is badly digested. The hydrochloric acid is often absent in the gastric juice (Rotenstein, Gans, Hönigmann). Sometimes there are lesions of the mucous tract (interstitial gastritis, atrophy of the glands); in other cases no distinct lesions have been found. Gans and Hönigmann claim to have found hyperacidity in certain cases.

The disturbances of the intestinal digestion are less known, because they are less accessible for investigation.

Among 140 diabetic patients Seegen found the liver enlarged in 28: about 20 per cent. Others have found a greater proportion of enlarged livers.

In 60 per cent. of diabetics there is a manifest change in the liver, usually in the right lobe. The density of the organ is increased in one-third and its sensitiveness in one-fourth of the cases. It is usually increased in size, this increase consisting of elements of induration. Glénard (La Semaine Méd., Aug. 3, '90).

In diabetics the function of the liver is unimpaired; cirrhosis and other intercurrent affections diminish or abolish glycosuria. Dujardin-Beaumetz (Bull. Gén. de Thé., Nov. 15, '91).

In case of diabetes due to influenza liver weighed seven pounds; hypertrophic cirrhosis with pigmentation throughout hepatic cells, portal spaces, and biliary ducts and vessels. Pancreas

large and striated; glands dissociated by fibrous tissue; cells infiltrated with pigment. De Massary (Bull. de la Soc. Anat., July 10, '95).

I have for a long time insisted upon the fact that during life the liver, being gorged with blood, presents a greater volume and consistency than in the cadaver. The differences concerning the condition of the liver in diabetes are, in a measure, due to this fact. In certain subjects attacked with severe diabetes, a brownish color of the skin, and especially that of the face, similar to that witnessed in Addison's disease.

Case of *diabète bronzé*, of which only 9 certain cases, all by French observers, and 2 doubtful ones have been published. Marie (La Semaine Méd., May 22, '95).

The liver is then atrophied and hard, and there may be ascites. Hanot and Chauffard published two cases of this kind in 1882. Cases were afterward reported by Letulle, Hanot and Schachmann, Brault and Galhard, Barth, and others. Upon section, the liver is found hard and distinctly and uniformly sclerotic, and a microscopical examination shows the hepatic cells to be infiltrated with yellowish-brown or black granulations, while at certain points there are large black masses. The sclerotic connective tissue shows by its topographical distribution the existence of bivenous cirrhosis. In the portal spaces obliterative endarteritis is found, with net-works of biliary pseudocanaliculi, masses of pigments, and vestiges of destroyed hepatic cells.

The liver is the seat of predilection for deposits of pigment, but it has also been found in the pancreas (Hanot and Chauffard); also in slight quantities in the kidney, and even in the heart. Finally, as I have already mentioned above, it occurs in the skin itself.

The quantity of iron chemically de-

terminated in the pigmented organs is variable: Quinke found in a case an enormous quantity of dry matter. The liver was said to contain, in all, 27 grammes. Zaleski justly remarks that this pigmentation is not characteristic of iron.

Urinary System.—Urinary complications are very common. First there are those due to previous morbid conditions (gout, for instance), and, in particular, there are those which depend upon the diabetic dyscrasia, and which, as is known, are *complex* in the case of gravel diabetes.

The renal lesion most common in diabetes has been reported by Armanni and fully described by Strauss.

It affects exclusively the zona limitans, where it invades the straight tubules of Henle, which may be either large or slender; sometimes, likewise, some of the collecting tubes (Strauss). As to the localization, there are individual varieties; in one instance it was found exclusively in the ascending branch of the loop.

Armanni regarded this lesion as a hyaline metamorphosis. Ehrlich, with the aid of iodized gum, proved that it is really an infiltration of the cells by the glycogenic substance. He regarded it as a constant symptom in diabetes; but this opinion appears to be somewhat exaggerated. At all events, this lesion proves the facility with which the organism synthetically transforms the sugar into glycogen. Ehrlich thought that the sugar so transformed was that contained in the urine. Strauss—basing his opinion upon the fact that the lesion is localized in the zona limitans in the neighborhood of the capillaries interposed between the uriniferous tubules—is inclined to believe that this sugar

comes from the blood of these capillaries.

[In support of this hypothesis the fact may be advanced that the glycogenic infiltration may take place in other organs besides the kidneys; the brain, for instance (Futterer). Very recently Strauss observed that the glycogenic reaction is sometimes absent, and that there is only a hyaline substance. R. LÉPINE.]

A method for detecting and fixing sugar in the organs just at the place of its excretion. Observations made on the kidneys of rabbits, diabetes having been produced experimentally. The kidney is removed rapidly, and a small portion is placed for fifteen to twenty minutes in a watery solution of phenylhydrazin and glacial acetic acid, previously warmed in a water-bath. It is then washed in water acidified with weak acetic acid, hardened in 10-per-cent. formol solution, frozen, and sections cut. The sections showed the characteristic yellow needles, indicating the presence of sugar, chiefly in the interstitial spaces between the uriniferous tubules. The crystals were much more scanty in the capsules of the glomeruli, while in the lumina of the uriniferous tubules they were almost absent. The chief masses of crystals were certainly situated in the interstitial vascular and lymph-spaces. Seelig (*Archiv f. experiment. Path. u. Pharm.*, B. 37, H. 2, 3).

In certain cases of severe diabetes, particularly when death has been caused by coma, Ebstein has seen a peculiar alteration in the epithelium of the convoluted tubules in which circumscribed areas alternate with normal portions. According to Albertoni, this lesion is due to the acetone or to the acids which exist in the blood in severe diabetes.

Quite recently, and only in cases in which death occurred during coma, Fichtner has reported a very circumscribed alteration in the cells of the convoluted tubules, which consists of an infiltration of fat at the base of these

cells, which is detected by osmic acid. I have also met with this alteration, to which the attention of pathologists should be directed.

In cases of diabetes 644 post-mortem examinations performed. The condition of the kidneys was carefully noted in 241 of these cases. In the remainder they were reported healthy, or only the gross appearances were noted. Of the 241 cases, 68 are reported as hypertrophic; 52 as hyperæmic; 94 as the seat of a nephritis; 17 as having fatty degeneration; 7 had epithelial accumulation; 2 had cysts; and 1 multiple abscess. Colcord (Kansas Med. Jour., Apr., '91).

Lesions similar to those in Bright's disease rarely occur in the diabetic kidney.

Several authors have dwelt upon the frequency of cystitis in diabetic subjects.

A complication which is much more rare is *pneumaturia*, in which the patient toward the end of micturition ejects a jet of gas through the urethra. In a patient observed by Mueller, the gas, which was collected under water, was composed as follows: H, from 44 to 57 per cent.; N, from 33 to 35; CO₂, from 9 to 19; O, traces; CH₄, traces. Freshly-voided urine contained 1 per cent. of sugar, but sometimes there was no trace of it. There is no doubt that the phenomenon of the fermentation of the sugar is due to the presence of micro-organisms in the bladder.

Skin.—The cutaneous complications occurring in diabetes are pruritus, eczema, and gangrenous lesions. The pruritus may exist without any appreciable lesions. It affects the genital organs, especially the glans penis in men. In women it is much more painful, affecting the vulva. It gives rise to an itching, burning sensation, with exacerbations, which may cause insomnia and various nervous symptoms. Sometimes

it occurs early and forms one of the symptoms revealing the existence of the disease. Diabetic eczema is of two varieties: either genital, in which case, like the pruritus, it appears to be due to the local irritation caused by the sugar, or general, when it occurs principally in arthritic subjects.

Chronic eczema, located in the genital organs in women, may be pachydermic. (Fournier.)

The gangrenous dermatoses have been carefully studied by Marchal, of Calvi, and more recently by Kaposi.

Furuncle and anthrax frequently complicate diabetes. Anthrax presents a somewhat peculiar type: beginning insidiously, and with but little pain; the œdema is slight and the febrile reaction is either slight or does not exist. Very frequently the affection is complicated with a phlegmon or with gangrene.

Diabetic gangrene is not nearly so rare as most surgeons suppose. Fourteen cases observed. T. G. Morton (Philadelphia Med. Times, Jan. 1, '89).

Gangrene of diabetes not believed to be due to the presence of sugar in the affected tissues, but to the ill results which follow infective processes in the diabetic. Infection of the skin in these patients is a common accident. There is usually itching and scratching, and by this means pyogenic organisms obtain entrance. Gussenbauer (Wiener med. Blat., Feb. 2, '99).

The gangrene may be primary in diabetes, without any previous phlegmon or anthrax. In this case it is dry or mummified, like senile gangrene. It begins most frequently in the toes, and has been seen to originate simply in a local asphyxia. I have already mentioned the diabetic perforating ulcer (see NERVOUS COMPLICATIONS).

Diabetic gangrene is not infrequently the first symptom to attract attention to diabetes in an apparently-healthy

person. Hence the necessity of examining the urine in cases of gangrene. Roser (Berliner klin. Woch., June 22, '96).

If a gangrenous inflammation occur in comparatively young persons, the urine should be examined, as diabetics may thus suffer from gangrenous inflammations. Diabetic gangrene often arises in the presence of arteriosclerosis; in 9 out of 11 cases observed severe arteriosclerotic changes were present in the small vessels. Koenig (Berliner klin. Woch., June 22, '96).

A form of lichen resembling exanthema has been described in diabetes. In a patient seen by Robinson touching the tumor caused a burning sensation.

Nine cases observed where psoriasis co-existed with gout or diabetes, or both; a causal relation between those affections does undoubtedly exist. Karl Grube (Berliner klin. Woch., vol. xxxiv, No. 52, p. 1134).

Cutaneous disorders observed in diabetes: Generalized xeroderma, which is quite common; eczematous dermatic manifestations occurring in any region of the skin, especially prone to attack the flexor surfaces, and more especially the genital, anal, and inguinal regions; furuncular and carbuncular manifestations are quite frequent in this condition, and are found generally in the nuchal and gluteal regions; erythematous lesions, some evanescent, others of the graver kind, as erysipelas, are commonly present; gangrene; dermatitis herpetiformis of Duhring; xanthoma diabeticorum; blastomycetic dermatitis. S. Sherwell (Med. News, June 29, 1901).

Locomotor Apparatus.—The cartilages may present the lesions upon which Krawkow dwells, which are due to a deposit of glycogen.

Frerichs refers to the lightness of the bones. They have been found to be extremely light in some cases. I have stated above that in serious cases the lime in the urine is relatively increased. Perhaps these anomalies bear less relation to the hyperglycæmia than to the

acid dyscrasia of the severe form of diabetes, to which we shall now refer.

Diabetic Coma.—Under this head have been grouped those cases in which the patient falls, in a very short time, into a comatose state, which is nearly always mortal.

Stosch, in 1828, appears to have been the first to mention this dangerous complication of diabetes. Twenty years later Prout related 4 cases of diabetes which terminated suddenly in death. Grisolle, Bence-Jones, Petters, Balthazer, Foster, Kaulich, Howship Dickinson, and others have reported similar cases, but the first extensive article on the subject is that of Kussmaul.

Frerichs separates these cases into three categories. We have already studied the first (rapid death by cardiac paresis, see above). In one of the remaining two the first appearance is not very sudden, there being premonitory signs: increased weakness, gastric disturbances, anorexia; the breath and urine nearly always give off the penetrating odor of acetone, and the urine, after the addition of perchloride of iron, usually presents a red color.

Very frequently, as I have already mentioned under SYMPTOMS, there is a decided difference between the quantity of sugar revealed by Fehling's solution and the smaller quantity registered by the polarimeter. According to my observations, the pulse is always accelerated, then cephalalgia sets in, and a peculiar dyspnoea, which is not explained by auscultation of the lungs, and which is characterized by a great frequency and depth of the respiratory movements. Occasionally there is cyanosis, with lowering of the temperature, then somnolence, ending in coma and death. The total duration of the symptoms in this variety is from three to five days.

In the third category of such cases the

dyspnœa does not exist: the patient becomes more or less suddenly excited as though intoxicated, vertigo, delirium, somnolence, and coma. In this variety, which is rather more rare than the preceding, the urine presents the same characteristics.

It is generally admitted that the pathogenic element of diabetic coma is an intoxication, but it has not yet been established with certainty to what substance this is due.

Petters—to whom, in 1857, the discovery of acetone in the urine of one of his patients is due—does not hesitate to attribute these accidents to the presence of this substance. This opinion was all the more readily accepted during a certain time, through the fact that the urine in the majority of severe cases of diabetes contains a considerable quantity of acetone (up to 3 grammes per day—Engel). Experiments, however, have not coincided with this interpretation, for animals support much larger doses without presenting the symptom of diabetic coma.

Gerhardt, who in 1865 discovered the fact that the addition of perchloride of iron to the urine of certain diabetes produced a red color, thought that it was due to the diacetic ether which decomposes readily in acetone, CO_2 , and alcohol. Von Jaksch attributes this coloration to the diacetic acid; but the fact that the injection of considerable doses of this substance does not give rise to symptoms resembling those of diabetic coma leads one to doubt that the accidents of diabetic coma are solely due to its presence.

Boussingault formerly found as much as 1.6 grammes of ammonia per litre of diabetic urine; this enormous daily excretion of ammonia appeared incredible, and Koppe argued against the exactitude

of Boussingault's method; but in 1880, Hallerworder fully confirmed the results of Boussingault, basing his observations upon the researches of Walter, made according to the directions of Schmiedeberg.

[These researches proved the fact that where a mineral acid penetrates into the blood ammonia is formed in the economy, by neutralization. R. LÉPINE.]

Hallerworder did not hesitate to affirm that in diabetic subjects there exists an excess of acid, perhaps lactic acid. Stadelmann, by treating all the acids and all the bases in the urine as had been done by Goethgens, found that, while in the normal urine the known acids exceed the bases, the contrary is the case in diabetic urine, and that consequently there must exist in the latter some unknown acid. As a matter of fact, from several litres of diabetic urine Stadelmann succeeded in directly extracting crotonic acid, and Minkowski, continuing his researches, proved that the crotonic acid does not pre-exist in the urine, but that it is a product of the decomposition of oxybutyric acid. At the same time Külz, in view of the fact that the urine of some diabetics deviates strongly to the left after the fermentation of the sugar, discovered, on his side, that this deviation is due to a substance of a composition identical with that of the known oxybutyric acids, but differing from the latter through the property of deviating to the left. Deichmüller, Zymanski and Tollens, Lépine and Hugounenq, and others have confirmed the existence of oxybutyric acid in the urine of certain diabetics.

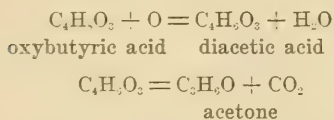
In twenty-one cases of diabetic coma all patients eliminated large quantities of acid; but a comatose condition may be due to increased destruction of nitrogenous material in other maladies, and administration of alkalies is without effect; hence, coma is not due to acid

intoxication. As means of restricting nitrogenous destruction, 8 ounces of fat daily; milk or levulose if disgust occur. Klemperer (Münch. med. Woch., May 14, '95).

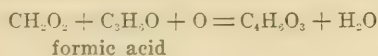
The most probable cause of diabetic coma is the formation and retention in the organism of the decomposition-products of sugar, such as acetone, diacetic acid, and more especially of beta-oxybutyric acid. These acids have frequently been found both in the blood and in the urine of patients suffering from diabetic coma. Among the predisposing causes of coma, age ranks as an important one, this complication of diabetes being especially frequent between 20 and 40 years of age. Among other causes, Cassoute notes an exclusively-meat diet and many agents, such as opium, which tend to restrain and diminish the glycosuria. Cassoute (Gaz. des Hôp., '96).

According to our present knowledge, it may be definitely stated that diabetic coma is due to an acid intoxication produced by the circulation of excessive quantities of beta-oxybutyric, and possibly also diacetic, acid in the blood, these being the products of the decomposition of the body-albumins. Thomas B. Futcher (N. Y. Med. Jour., vol. lxvi, No. 25, p. 821, '97).

It is generally admitted that acetone arises from the decomposition of oxybutyric acid, according to the following equations:—



Von Jaksch has supposed that the acetone, instead of originating from the diacetic acid, might, on the contrary, give rise to it, by combining with the formic acid.



The quantity of oxybutyric acid eliminated per day is not insignificant, for 4 grammes of ammonia neutralize about

30 grammes of oxybutyric acid, and some diabetics excrete more than 4 grammes of ammonia daily.

There can hardly be a certain parallelism between the excretion of ammonia and that of the oxybutyric acid.

The ammonia may either be saturated with other less known acids or its formation may be due to other factors.

It must, moreover, not be forgotten that oxybutyric acid is not peculiar to diabetic coma. Minkowski has eliminated 3 grammes from a non-diabetic woman, attacked by pseudoscorbutus in a case of lateral amyotrophic sclerosis.

To sum up, there seems to be no doubt that in a certain number of cases of severe diabetes the blood is less alkaline. Is this lesion the cause or the effect of the symptoms? I am inclined to believe, with the majority of authors, that it is in part the cause, and I am surprised at the opposite interpretation given by Klemperer, who says that the blood is acid because there is coma. Clinical observations seem to me to contradict this view, for the lack of alkalinity of the blood precedes the beginning of the coma. Finally, the cases in which purely-alkaline treatment, according to Stadelmann's method, has been manifestly useful would seem to favor the opinion which I defend. I have myself seen several such cases.

It is likewise an incontestable fact that the acid intoxication is merely an element of the diabetic coma. It is certain that the kidney is not healthy when the symptoms present themselves (see above the lesions of Ebstein and of Fichtner). Finally I may mention lipæmia, to which English physicians attach a pathogenic value.

From a review of opinions of various well-known surgeons, and from personal limited observations, it appears that the presence of glycosuria in those indi-

viduals who may have surgical diseases does not in itself constitute an absolute contra-indication to any and all surgical relief. Very great judgment must be exercised in the selection of cases, in the determination of the kind and extent of the operation to be performed, and the strictest surgical asepsis must be rigidly observed throughout. Infection, when it occurs, is from without, and is the result of an error in the technique. When infection does not occur, the operative wounds heal kindly, but slowly, especially in granulating wounds. The vascularity of the tissue must be interfered with as little as possible. This is particularly so in gangrene of the extremities, in which the statistics of Heidenheim, Kuster, and Smith and Durham show most conclusively the necessity of high amputations in these conditions. Personal opinion is that it is better to cut down upon and ligate the artery in gangrene of the extremities rather than to attempt the bloodless amputation by means of the Esmarch band. A. L. Fisk (*Annals of Surg.*, Apr., 1900).

Acute Form.—Diabetes, in the great majority of cases, is an affection progressing in a chronic condition, but in some cases the onset is sudden and the progress of the disease acute.

Out of 77 cases of children traced to their termination, 14 recovered, 7 improved, 4 remained unimproved, and 52 died. C. Stern (*Archiv f. Kinderh.*, B. 11, H. 2, '89).

Gravity of prognosis of diabetes in children. Of 108 cases, 64 per cent. terminated fatally. Prognosis graver in proportion as children are younger. Wegeli (*Archiv f. Kinderh.*, B. 19, H. 1, 2, '95).

In adults proportion of grave cases does not exceed 5 per 1000. Worms (*Bull. de l'Acad. de Méd. de Paris*, July 23, '95).

The rate of mortality from diabetes has risen, in Paris, within the last ten years, from an average of 8 in each 100,000 population to an average of 13; while in Copenhagen it has risen from 5 to 8; and in England and Wales it has increased, in fourteen years, 70 per

cent., after allowing for the increased population. Saundby (*Editorial, Modern Med. and Bact. Rev.*, Apr., '97).

Authentic cases of this nature are rare, because the evolution of the disease may actually have been an incipient one, and have remained unnoticed up to a certain period, when there is a sudden aggravation.

[Loeb reports the case of a chemist who, while in good health, examined his own urine and found it normal. Soon after he became ill, and experienced violent thirst. At this time the urine contained 8 per cent. of sugar. Death took place in five weeks. R. LÉPINE.]

Death is not invariably the termination of acute diabetes. Several cases of recovery have been reported. Holsti saw, in a man 41 years old, diabetes having a very sudden beginning, to judge by the thirst, and which was only subjected to the dietetic treatment six weeks later. After three days abstinence from amylaceous food the urine, which had contained 8.8 per cent. of sugar, ceased to contain any, and the future use of amylaceous food did not cause a return of the diabetes. This is assuredly a rare case. More frequently a diabetes having an acute beginning passes to a chronic condition.

A mild form of diabetes has sometimes been described as *intermittent*; it is due in a measure to the influence exerted by a too liberal alimentation. As soon as a proper diet is followed the glycosuria does not exist.

This is not, properly speaking, an intermittent diabetes. Such cases belong rather to the type of alimentary glycosuria.

Study of six cases of recurrent transitory diabetes. The proportion of sugar was very variable, but usually 30 to 40 g. a day. The glycosuria diminished rapidly under a rigid diet. The amount of sugar was invariably less in the second and third attacks than in the first,

but the attacks lasted longer with each relapse, 1 or 2 g. of sugar persisting for weeks or months. As a rule, there was albuminuria, which subsided with the glycosuria. The proportion of uric acid was high. In all cases there was a moderate degree of polyuria. Thirst and hunger were never marked, but emaciation, sense of physical exhaustion, and depression were prominent symptoms; these recurred with diminished intensity with each attack. Months or years of perfect health sometimes intervened with the attacks. In one case ordinary diabetes supervened. The recurrent transitory variety of diabetes is connected in certain cases with a constitutional arthritism, in others with an acquired arthritic tendency. Transitory diabetes is not dangerous in itself; it is the expression of an enfeebled constitution or a passing dyscrasia. Dreyfus Brissac (Sem. Méd., Feb. 12, '97).

True intermittent diabetes is almost independent of the alimentation. It has been reported by Bence-Jones, Baudremont, and others. Saundby reports one case. I have myself seen one alternate with albuminuria. This form of diabetes is principally met with in arthritic and hysterical subjects. Its appearance depends principally upon nervous causes, moral or otherwise.

Diagnosis.—A well-defined diabetes cannot be mistaken by an experienced physician. The general symptoms and the glycosuria establish the diagnosis.

DIAGNOSIS BY EXAMINATION OF THE URINE.—If the percentage of sugar found in the urine is considerable, doubt is impossible. If, on the contrary, a minimum quantity is found, it may be questioned whether there is not merely a condition of temporary glycosuria. This should never be lightly decided; it requires a careful watching during several days to make sure of the actual condition.

All cases with sugar in the urine are cases of true diabetes, whether the sugar

be extremely small in amount or even be entirely absent for a time. Ebstein (Centralt. f. innere Med., Nov. 21, '96).

The urine of persons taking rhubarb, santonin, or some other substances gives a reaction that might be mistaken for that of sugar. S. A. Hazen (New York Med. Jour., Jan. 29, '98).

It is in the cases in which lesions of the nervous system, and particularly of the brain, exist that the diagnosis becomes most difficult, and the common tendency to regard glycosuria as a consecutive symptom must be guarded against. The diagnosis is usually easier where paraplegia and glycosuria co-exist. It is a known fact that a neuritis of the lower members in a diabetic patient may simulate *tabes dorsalis*, but it would, however, be a rare condition when co-existing with glycosuria. The following are the differential characteristics:—

1. The walk of the patient. Were symptoms of diabetes present before the motor disturbances?

2. The symptoms proper of diabetes: the abundance of the urine and of the glycosuria, the presence of acetonuria, etc.

3. The symptoms peculiar to *tabes*, particularly motor inco-ordination, which is not present in diabetes; in the latter affection "steppage" exists, which symptom does not occur in *tabes*.

Among symptoms characteristic of both *tabes* and diabetes are irregular areas of anæsthesia or analgesia; paresthesiæ, especially about the legs and sexual organs; increased sensitiveness toward cold; lancinating pains; diminished sexual vigor; and trophic and secretory disturbances, such as *malum perforans pedis*, *decubitus*, *hyperidrosis*, and muscular atrophy. Both diseases rarely occur together. W. Croner (Zeits. f. klin. Med., vol. xli, Nos. 1-4, 1900).

Besides these fundamental differences, there are several other signs of secondary importance, such as shooting pains,

which, although they may exist in diabetes, as reported by Charcot, Raymond and Oulmont, Bernard and Féré, and others, are of sufficiently-rare occurrence. The vesical disturbances existing in diabetes have nothing in common with the vesical and urethral attacks which occur in tabes; the ocular paralysis, which is a frequent symptom in tabes, very rarely occurs in diabetes; in those cases in which there are disturbances of vision, an examination of the fundus will dispel all uncertainty: in diabetes retinitis will be found; in tabes atrophy of the optic nerve. If the latter lesion is not sufficiently pronounced to be recognizable, it should be remembered that in the amblyopia of diabetes the optic disturbance is bilateral from the beginning, while in tabes it most frequently begins in one eye.

The above refers to the diagnosis between diabetes and glycosuria of nervous origin; but the latter variety is not the only one which may be mistaken for diabetes. I will first refer to alimentary glycosuria, which occurs in certain subjects after a very copious ingestion of the hydrocarbons; it also occurs in nearly every subject after the ingestion of a sufficient quantity of glucose during a short space of time (*at least* 200 to 300 grammes for certain persons). Alimentary glycosuria was first observed in certain cirrhotic subjects by Cotrat, afterward by myself and a number of others (Quincke and others), but the affection is not best seen in cirrhotic patients. Krauss and Ludwig observed a young girl suffering from Basedow's disease who, after the ingestion of from 100 to 200 grammes of pure glucose, excreted very nearly 17 per cent. of the glucose ingested.

It often happens that very fat people will show glucose in their urine after a

meal containing a fairly large quantity of sugar. The glucose disappears from the urine of those fleshy, diabetic patients who are being treated for obesity though not placed upon a strict diabetic diet. The glycosuria which so often follows traumatic neurosis is due to an excessive diet combined with a lack of active exercise. Hirschfield (*Med. News*, Jan. 28, '98).

Recognition of the "alimentary" form of diabetes is effected not only by the elimination of sugar being susceptible of control by the exclusion of carbohydrate matter from the food, but also by the absence of the products, diabetic and oxybutyric acids, of tissue breaking down. If the ferric-chloride test for these products gives no reaction, case is thus far only in the alimentary form. F. W. Pavy (*Lancet*, June 23, 1900).

Chvostek, at Meynert's clinic, was also able to produce alimentary glycosuria with great facility in patients suffering from Basedow's disease. Evidently these patients, owing to their nervousness, are particularly predisposed to glycosuria. In some subjects, on the other hand, it is almost impossible to induce alimentary glycosuria.

The glycosuria which sometimes follows certain acute maladies, and some surgical affections and cases of poisoning, cannot well be mistaken for diabetes, as the other existing conditions would arouse the attention of the physician. Moreover, this form of glycosuria is always very mild.

Case of myxœdema in which the ingestion of thyroid tablets caused glycosuria. Ewald (*Deut. med. Zeit.*, No. 60, '94).

Under fresh thyroid-gland diet animals are affected with tachycardia, considerable emaciation, polyphagia, polydipsia, and temporary glycosuria. Georgiewski (*Centralb. f. die med. Wissenschaften*, No. 27, '95).

Marked polyuria with glycosuria is produced in animals by caffeine-sulphonic acid. Jacoby (*Archiv f. exper. Path. und Pharm.*, B. 35, H. 2, 3, '95).

Chloralamid, $1\frac{1}{2}$ to 3 drachms per day, frequently causes glycosuria. Manchot (*Virchow's Archiv für Path. Anat. und Phys. und f. klin. Med.*, B. 136, p. 368, '95).

This is not always the case when the glycosuria is due to the ingestion of phloridzin.

Phloridzin diabetes appears more intense when the liver contains no glycogen. Pick (*Archiv f. exper. Path. und Pharm.*, B. 33, p. 305, '95).

It is known that the proportion of glucose contained in the urine may be as great as in very severe diabetes; consequently, there are only two ways to avoid being deceived by a patient who hides the fact of having taken the phloridzin. The patient must be closely confined and be deprived of phloridzin. On the other hand, the blood-corpuscles must be carefully examined for the reaction of Bremer (see farther on). In cases of phloridzie glycosuria, this reaction will not be present, or, in the worst case, will be exceedingly doubtful.

Since the works of Blot it is known that sugar is frequently present in women during parturition.

Forty-six women examined, 9 of whom were pregnant, 25 delivered, and 12 nursing. In pregnancy in the last month no trace of sugar was observed; in 10 women recently delivered the presence of sugar was positively ascertained; in 3 cases but slight traces were found, and in 12 others there was no sugar present. The glycosuria appeared about from three to five days after delivery, during the increased secretion of milk, disappearing when the secretion diminished. No glycosuria was observed in nursing women. The condition appears only when the secretion of milk is in excess of that required for the child. Berberoff (*Wratsh, No. 16, '93*).

Diabetes is a rare complication of pregnancy. Study of one personal case, and twenty-four reported by other observers. About one-half of these ac-

quired diabetes during pregnancy, the other half already having the disease before pregnancy occurred. In the former class recovery took place in about three-fourths, with, however, an exhibition of a tendency to recurrence in subsequent pregnancies. In the class in which pregnancy occurred in women already subjects of diabetes, safety through delivery and the lying-in period was apparent in about two-thirds of the cases. Death of the foetus is noticed in about one-half of the cases. Premature delivery is observed in a large proportion of the reported cases, due to the presence of the dead foetus rather than the direct influence of diabetes. There were 6 deaths in coma or collapse during or near the time of labor: 1 in a woman who had diabetes before gestation, while 5 were in patients who acquired the disease during pregnancy. Partridge (*Med. Record, July 27, '95*).

It may be necessary in some cases to question the existence of a true diabetes. To establish the diagnosis, reliance may be placed upon the fact that, in the case of a false diabetes, the secretion of milk is always arrested, and that the sugar contained in the urine is not glucose, but lactose, which fact has been established by Hofmeister, and, after him, Kaltenbach. It would appear, however, according to Blot, de Sinéty, and several more recent observers, that the lactose may be partially transformed into glucose; so that the presence of a fermentable sugar (glucose) in the urine of a parturient woman would not uncontestably prove the fact that the patient was a diabetic. I may here call attention to the fact that Mathew Duncan found true diabetes in a pregnant woman. The child was also said to be a diabetic!

A gross error committed by inexperienced persons consists in regarding a subject diabetic whose urine reduces cupro-potassic fluid, but which, in reality, does not contain a trace of sugar. This

error is the more regrettable through the fact that the restriction to an animal diet may aggravate the condition of the patient instead of improving it, for the animal diet favors the production of reducing substances in the economy. Among these substances are uric acid, creatinin, allantoin, mucin, oxyphenol, pigments, and above all the components of glycuronic acid.

How is this error to be avoided?

1. In non-albuminous urine deprived of the greater part of its uric acid by a preliminary cooling (on ice) and by filtration, the existence of sugar may be admitted if the reduction of the cupropotassic fluid takes place in the cold state, as the reducing substances only exert their action at the boiling-point. Sugar, itself, in the cold state, only causes a reduction at the end of several hours.

If one does not wish to wait, recourse may be had to the following process, which is a modification of that proposed by Worm-Mueller, to determine whether the reduction by heat is partially due to a small quantity of sugar. The exact quantity of urine required to discolor 1 cubic centimetre of Fehling's solution must first be determined, then a portion of the same urine is fermented; this being accomplished, it must then be ascertained whether a greater number of cubic centimetres will be required to discolor the same quantity of Fehling's solution.

It is clear that, if a larger quantity is required, a portion of the reducing power was due to a certain quantity of sugar. This method is exact, and its only defect is that it is not within the reach of the ordinary practitioner, owing to the precision of the dosages required.

To lessen the error due to the reducing substances, it has been advised to

dilute the urine to the fifth and even the tenth degree. Indeed, this should always be done when the urine is very highly charged with sugar; but when there exist only doubtful traces of it, the dilution of the urine is a positive means of not being able to obtain the sugar. This process should consequently be rejected.

On the other hand, the following method, which is, moreover, a classical one, is perfectly reliable. About 4 grammes of Fehling's solution are poured into a tube; it is heated to the boiling-point, then one to two centilitres of urine, non-albuminous, which is supposed to contain sugar, should be made to flow along the side of the tube, which should be inclined. It is well to first heat the urine slightly; otherwise the inclined tube should be held above a flame for several moments in order to sufficiently raise the temperature at the point of contact of the two liquids. After a few moments, if sugar is present, a green ring will be seen to form, which will then rapidly change to yellow, and afterward to red, which will contrast decidedly with the blue color of the subjacent liquid. This reaction is easily accomplished, and, if a red ring is obtained, it is of great value, for the reducing substances only produce hydrate of oxydule, which is of a yellow color.

Jastrowitz recently advised examination, by means of the microscope, of the precipitate of oxide of copper. As a matter of fact, none of the reducing substances, uric acid, creatinin, nor the components of glycosuric acid, etc., produce a crystalline precipitate. According to the author, these crystals are tetrahedral and octahedral. These are actually the forms obtained when a watery solution of glucose is made to

react upon Fehling's solution, but, according to Jastrowitz, small spheres may also be produced with urine containing a slight amount of sugar. Thus, when, under the microscope, these (spheres) predominate, provided they are accompanied by tetrahedral and octahedral crystals, it may be affirmed that sugar is present in the urine.

It is possible to partially rid one's self of the reducing substances, by means of a process described a long time ago by Seegen, and which is to be recommended on account of its simplicity. The urine is filtered through animal charcoal as many times as are necessary to discolor it; then the charcoal is washed in distilled water, and the two filtered liquids—the urine and the distilled water—are treated separately by Fehling's solution.

The reason is as follows:—

The charcoal not only retains the coloring matter and the uric acid, but likewise certain substances, as yet not well known, which prevent the precipitation of the oxide of copper. Therefore we are better able to search for the sugar with the filtered water than with the urine. Furthermore, the charcoal has retained a large portion of the sugar contained in the urine, and gives off into the distilled water a larger portion of the sugar than of the other substances which it had retained. Consequently the reduction of Fehling's solution is much more easily accomplished by this water than by the urine.

These are the advantages of Seegen's method, by means of which the author is able to discover a one-thousandth part of sugar in the urine. Even with a smaller proportion there will be a reaction, but this will only become apparent, says Seegen, after several minutes' heating. No other method surpasses this in

sensitiveness, and it is most easy of application, *provided a perfect animal charcoal is at hand.*

To summarize what I have already stated in the beginning, Fehling's solution, provided one knows how to use it, is capable—all statements to the contrary notwithstanding—of alone determining the existence of sugar. The reducing action of glucose upon the oxide of bismuth in the presence of an alkali has also been resorted to for a long time. This reaction, called that of Böttiger, which is described in all the treatises on urology, is far from being valueless, especially when made use of with the modification indicated by Nylander.

Leaving aside several other reactions, which have not come into general use, because they are not sufficiently accurate, I pass on to the reaction of phenylhydrazin, described by Fisher, and employed by von Jaksch for the discovery of glucose in the urine. This reaction is based upon the property, peculiar to phenylhydrazin, of forming, when in combination with glucose, a crystalline substance of a decidedly-yellow color.

Jaksch obtains this reaction as follows: 10 cubic centimetres of the urine to be tested are poured into a tube, adding three pinches of the acetate of soda in crystals, also two pinches of hydrochlorate of phenylhydrazin. The mixture is placed for a time in a water-bath. After it has cooled a yellow, crystalline deposit is formed, which, under the microscope, appears to be composed of fine needles, some isolated, others in bunches, and some assuming star-formations.

It has been said that this reaction is not absolutely characteristic, and that glycuronic acid will also cause needle-formations; but Hirschl has ascertained that by leaving the tube one hour in the water-bath the glycosuric components do

not give rise to a crystalline precipitate, and Binet, who has made a very complete study of this important reaction, considers it as absolutely reliable with the following slight modifications:—

Ten cubic centimetres of the urine to be examined, deprived of albumin, are taken and cleared by means of a few drops of an acetate-of-lead solution. It is then filtered, and a few drops of acetic acid, three pinches of acetate of soda, and two of hydrochlorate of phenylhydrazin are added. The whole is left in the water-bath for one hour. The tube is then allowed to cool, and on the following day the urine is examined with a very powerful magnifying-glass. Under these conditions no balls or granular masses are found, but yellow or silvery crystals, characteristic of phenylglucosazone. According to Binet, by proceeding in this way, one two-thousandths of sugar is distinguishable—an exceedingly small proportion. The reaction, which is absolutely correct, is, therefore, an extremely-sensitive one.

I do not believe that fermentation surpasses it in this respect. Beer-yeast alone, and likewise the urine itself, when left undisturbed, give rise to some gas-bubbles. Thus, in order to arrive at the certainty of the existence of the sugar, a test experiment must be made. Two similar test-tubes are prepared, the suspected urine is placed in one, and normal urine in the other, an equal quantity of yeast is added to each one, and they are left under the same conditions during twenty-four hours.

One thousand specimens of normal and pathological urine examined with the view of ascertaining whether traces of sugar must be looked upon always as pathological. Using the phenylhydrazin and the fermentation tests as the most delicate tests for sugar, 58 per cent. of the analyzed urine showed no trace

of sugar; traces of sugar cannot, therefore, be looked upon as normally present in the urine.

Of the tests which, in doubtful cases, prevent the possibility of a mistake, the phenylhydrazin test must be cited. The only drawback of the test is the formation of crystals similar to the phenylglucosazone crystals, if glycuronic acid be present in the urine. However, the microscopical appearance of the two sets of crystals is sufficiently distinctive. The phenylglucosazone crystals occur in the form of bundles of long needles and of separate needles; the crystals of glycuronic acid appear in the form of rosettes, the needles are thick and plump, and the whole resembles the crystals of ammonium urate. The delicacy of the test is interfered with in albuminous urines and in urines which are concentrated or rich in urates. A. Jolles (*Centralb. f. klin. Med.*, Nov. 3, 10, '94).

Glucose is not a normal constituent of the urine; high specific gravity does not always indicate the presence of sugar; not infrequently concentrated urines with a specific gravity of 1028 to 1032 contain no sugar; small quantities of sugar influence the specific gravity very little. Trommer's and Worm-Mueller's tests are confusing. In the Fehling-Wendrin test results did not always agree. Hoppe-Seyler's test with alphanitro-phenylpropionic acid is not adapted as a single test. Its delicacy lies at about 0.4 per cent. Jolles (*Amer. Med.-Surg. Bull.*, July 5, '95).

In two clean and dry test-tubes 10 cubic centimetres of normal and diabetic urine, respectively, are placed; 0.5 milligramme or less of finely-rubbed-up gentian-violet is then allowed to drop on to the surface of the urine. In diabetic urine the superficial layers of varying depth are colored blue or violet-blue, and this color does not disappear on shaking. In normal urine, even after shaking, no color, or only the faintest trace, is developed. Merck's gentian-violet B is the best. In low temperatures the reaction is not so marked. The addition of mineral acids or sugar to normal urine will not lead to the

development of this color-reaction, which is really due to the presence of reducing substances in the diabetic urine. Bremer (*Centralb. f. inn. Med.*, Apr. 2, '98).

To 10 cubic centimetres of the urine are added 5 cubic centimetres of a concentrated solution of neutral lead acetate, and then, after shaking, 5 cubic centimetres of basic lead-acetate solution. When the whole is filtered, an almost clear colorless fluid should be obtained. Then equal parts of the filtrate and a watery solution of methylene-blue (0.3 per cent.) are placed in two different test-tubes, and to the tubes containing the methylene-blue is added 1 cubic centimetre of a 10-per-cent. caustic-potash solution for each 5 cubic centimetres, so as to make it strongly alkaline. This latter tube is then heated over an open flame, and the contents of the other tube are poured into it, and the whole boiled. If sugar is present, the dark-blue color is changed to a whitish one; the solution then becomes transparent, and finally a pale yellow. The lowest limit lies at about 0.04 to 0.05 per cent. of sugar; the reaction with a urine containing 1 in 1000 sugar is slow. Frölich (*Centralb. f. inn. Med.*, Jan. 29, '98).

To recapitulate, Seegen's method with Fehling's solution, the phenylhydrazin reaction, and fermentation are the three methods capable of recognizing with certainty the presence of a small quantity of sugar. The first is by far the most rapid. The phenylhydrazin requires at least two hours and the fermentation test twenty-four hours.

Nitropropiol test: A tablet is dropped into 10 or 15 drops of urine, diluted with about 10 cubic centimetres of distilled water, and warmed slightly. If sugar is present the solution turns first green and then blue. If but a small quantity is present, this can be concentrated by shaking with chloroform, as in the indican reaction. The reaction does not occur with biliary pigments, uric acid, albumin, blood, or phosphates. Neither does it occur in the urine of patients who have been

taking benzoic acid, chloral, carbolic acid, guaiacol, iodine, the salicylates, senna, or turpentine. Gebbart (*Münchener med. Woch.*, Jan. 1, 1901).

A new test for sugar is to take about 20 drops of urine in a test-tube and add a small amount (about $\frac{1}{10}$ gramme) of pure hydrochloride of phenylhydrazin, about $\frac{1}{2}$ gramme of crystallized sodium acetate, 2 cubic centimetres of water. This is heated over a flame until it boils, then 10 cubic centimetres of a 10-per-cent. sodium-hydrate solution is added, the tube being inverted five or six times and then stood aside. After a few seconds a striking reddish-violet color should make its appearance. The color is seen by holding the test-tube up to the light, when the whole fluid should be colored, not merely the deposit upon the bottom of the tube. The color should appear within five minutes. E. Riegler (*Deutsche med. Woch.*, Jan. 17, 1901).

I have yet to refer to certain very rare cases in which, although the urine responds to Fehling's test and becomes brown by the addition of caustic potash, it does not actually contain sugar, but instead alcaptone. In these cases there is no polarimetric deviation nor any alcoholic fermentation.

The diabetograph is an instrument devised for the purpose of rapidly and automatically estimating the amount of sugar contained in the urine of diabetic patients. It consists of a glass cylinder 20 centimetres in length, bell-shaped at the mouth, tapering to the other extremity, where there is a stop-cock. Figures are marked along the tube. The cylinder is filled with the urine to be analyzed, and by careful management of the stop-cock allowed to flow drop by drop into a small glass receptacle in which 2 cubic centimetres of Fehling's solution diluted with six times its volume of distilled water has been allowed to come to the boiling-point. When the desired reaction is obtained, the number opposite the level of the urine in the tube will indicate the amount of glucose to the litre of the

urine. F. Coulon (Archives Gén. de Méd., Sept., 1900).

THE DIAGNOSIS OF DIABETES BY MEANS OF THE BLOOD.—Bremer, as we have already mentioned above, has found that the red corpuscles of diabetic blood cannot be stained with aniline colors in the same way as the blood-corpuscles of the normal blood. The latter are distinctly acidophilous, while in the diabetic blood they become basophilous; they no longer take up eosin, the preferred color of the normal blood-corpuscles.

This reaction, which Bremer has subjected to several variations, is of great importance in cases in which a diabetic patient, who has no actual sugar in his urine, wishes to conceal his disease from the physician of an insurance company. It is important to know, however, that this reaction is, as Bremer has stated, independent of the glucose, not pathognomonic of diabetes. It may, also, take place in the corpuscles of leukæmic blood. (Lépine and Lyonnet.) See **COMPLICATIONS**.

Bremer's test of the blood of diabetics modified by staining two minutes in a 2-per-cent. methylene-blue solution and then ten seconds in a 25-per-cent. eosin solution.—This reaction was obtained in the blood in all cases of diabetics whose urine contained more than 2 per cent. of sugar. Loewy (Fort. der Med., Mar., '98).

Reaction of diabetic blood may be obtained as follows: 4 cubic millimetres of water are placed in the bottom of a small, narrow, test-tube. To this are added 20 cubic millimetres of blood, 1 cubic centimetre of a watery solution of methylene-blue (1 to 6000) and 40 cubic millimetres of liquor potassæ. The test-tube is then placed in boiling water for four minutes, at the end of which time, if the blood is diabetic, the blue color of the mixture will have disappeared and a dirty-yellow color will have taken its place. The reaction has been obtained

in all of forty-three cases of diabetes. R. T. Williamson (Lancet, Aug. 4, 1900).

Etiology.—Statistics referring to thousands of cases show that diabetes is most prevalent between the ages of 50 and 60 years.

Age is usually regarded as a factor in the etiology, and, according to a personal analysis of 2115 cases, the period of its greatest frequency extends between 30 and 60 years of life (the greatest number fall between 50 and 60 of any of the decades). Diabetes mellitus prevails to a much greater extent in some localities than in others; for example, in Malta it is a scourge of greater severity even than tuberculosis is in Germany. It is common in Sweden, and very frequent among Jews, wherever they may live. Schmitz (Berliner klin. Woch., July 6, '91).

It is probable, however, in view of the difficulty frequently experienced in determining the exact onset of the disease, that it often begins before the age of 50. The disease is relatively rare in childhood. No cases were known in which the disease existed in early childhood until very recently (during the past few years), when several cases have been published.

One hundred and seventeen cases in children collected. The disease is not near so rare in children as has been commonly supposed. As to sex, of the 117 cases, 47 were females, 31 males; of the remainder, the sex was not determinable. The proportion of males to females was 5 to 3. As to the age itself, 6 were found under 1 year, 1 seeming to be born with it, as it was noted a few days after birth; 7 were over 1 year, 3 over 2 years, 7 over 3 years, 6 over 4 years, 5 over 5 years, 1 over 6 years, 6 over 7 years, and 2 cases had completed 8 years; 8 were 9 years old, 6 were 10 years, 9 were 11 years, 8 were 12 years, 9 were 13 years, 5 were 14 years, 4 were 15 years old. Of the remaining 28 the age was not given. The children appeared generally of the better class. As to the etiology, heredity was

conspicuous, since the parents were often diabetic. Next to heredity, previously-existing disease was found; the most frequent cause was notably gastric catarrh. C. Stern (*Archiv f. Kinderh.*, B. 11, H. 2, '89).

The urine of 50 nurslings between the age of 1 day and 4 weeks examined. This number included 24 healthy children, 1 premature child, 1 case of hydrocephalus, 14 cases of acute and chronic gastro-enteritis, and 10 cases of other forms of dyspepsia. Among the 50 cases the urine of 10 caused a reduction of Trommer's test with cupric sulphate. In 2 cases the results were confirmed by observations made with the polarimeter. These 10 cases included 7 of aggravated gastro-enteritis which terminated fatally, and 3 of mild dyspepsia. Grösz (*Pester Med.-Chirurgische Presse*, No. 37, '92).

It appears upon a study of 108 cases of infantile diabetes that children of both sexes seem to be affected in an equal proportion, and that the disease is most frequently observed about the age of 5 years. As a cause, traumatism was found in 11 cases; dentition, chill, excesses of various kinds, rapid growth, insufficient food, violent emotion, or sorrow in others. Wegeli (*Archiv f. Kinderh.*, B. 19, H. 1, '95).

The disease is exceedingly fatal in young children. Whenever a child is brought to the physician with a rapid atrophy he should examine the urine for sugar. H. D. Chapin (*Jour. Amer. Med. Assoc.*, Sept. 15, 1900).

Men are much more likely to be attacked by diabetes than women. In childhood sex has no influence.

Out of 1004 cases of diabetes, 837—or 83.37 per cent.—were males, and 167—or 16.63 per cent.—were females. A. Cantani (*Deut. med. Woch.*, Nos. 12 to 14, '89).

The proportion of males and females in the white race who suffer from diabetes is about 3 to 2. In children, however, the ratio is not the same; girls have it more frequently than boys. In the colored race the cases occur more frequently in women than in men.

Futcher (*Johns Hopkins Hosp. Bull.*, Feb., '98).

The frequency of diabetes varies very much in different countries.

In Danish cities the mortality from this disease has almost quadrupled itself during the last thirty years. In Paris, between the years of 1865 and 1873, only 2 to 3 in each 100,000 died annually from diabetes. By 1892 the numbers had risen to 13 in 100,000. The disease is exceedingly common in India, in Russia it is very uncommon, and in Normandy it is wide-spread. Lépine (*Rev. de Méd.*, '96).

In the absence of sufficiently-reliable statistics, it is preferable to abstain from giving any figures. In the same country different races are very unequally affected, and on this point, also, it is necessary to await further researches. A fact which may be positively stated at present is the relative frequency of diabetes in the Jewish race.

In Frankfort-on-the-Main 171 persons died from diabetes during a period of nineteen years. Of 156 of these cases, 51 were Jews and 105 belonged to other denominations. The mortality from diabetes is six times as great among Jews as in other religions. Wallach (*Deut. med. Woch.*, Aug. 10, '93).

Two hundred and two deaths from diabetes in the city of New York during 1899 shows that the greatest mortality occurred between the fifty-fifth and sixty-fifth years, and diminished rapidly toward the end and beginning of life. Fifty-seven were born in Germany, 51 in United States, and 37 in Ireland. At least 54, or 25 per cent., were Jews and 51 were Irish. The potent influence is believed to be the breeding in and in, to which the Jewish and Irish races still adhere. Coma was direct cause of death in 60 cases. Gangrene was the most frequent complication, and appeared in the foot or leg in 32 cases. H. Stern (*Med. Record*, Nov. 17, 1900).

Diabetes is frequently hereditary, inasmuch as several members of one and the same family are frequently affected with

the disease; but the heredity is seldom direct.

The diabetic predisposition is hereditary. In 998 cases out of 2115 it was discovered positively that there were, or had been, 1 or 2 cases of diabetes among their blood-relations, and in some cases more. Schmitz (Berliner klin. Woch., July 6, '91).

It has been justly remarked that these diabetic families are tainted with the uric-acid diathesis, and that obesity, gout, and neuropathic affections exist in extraordinary frequency in such families. Frequently obesity and diabetes co-exist in the same person. A too exclusively-starchy diet and the abuse of wine and ciders are predisposing causes of diabetes.

In the canton of Zurich diabetes is rather rare, but 23 cases being recorded among 33,424 dead of all causes in a space of five years. The disease seems to be somewhat more frequent in the poorer classes, 6 cases out of 1000 dispensary patients being met with. Leva (Deutsches Archiv f. klin. Med., B. 36, H. 1, 2, '91).

In 200 cases there were found 4 intemperate, 107 temperate, 89 total abstainers, 69 opium *habitues*. Mitra (Indian Med. Record, June 1, '95).

In 607 persons engaged in manual labor or requiring great muscular and respiratory activity, no sugar was found in any case; in 100 persons engaged in intense intellectual work, sugar was found in 10. Worms (Bull. de l'Acad. de Méd. de Paris, July 29, '95).

Diabetes appears more frequently in March, April, July, and November; increased mortality in winter, but not in relation with average temperature. Davis (Amer. Jour. of the Med. Sciences, July, '95).

The increase of diabetes is much more pronounced among the wealthy classes than among the poor, the average in the poorer parts of the city being only 7 to 9 in 100,000, while in the wealthy quarters the average is 16 to 20. Bertillon (Editorial, Modern Med. and Bact. Rev., Apr., '97).

Obesity, gout, and diabetes are closely related. Any two or all three of them may be present in the same person. The diseases are hereditary, and are especially prone to descend to those children that most closely resemble their parents in external features. Certain individuals in whose family obesity is hereditary become obese despite a moderate diet and an active life. There must be some abnormality of the protoplasm of the cells. Uric acid is an abundant factor in the etiology of gout. In view of the fact that uric acid is a derivative of the nuclei of the cells, it may be inferred that in gout also the cell-protoplasm is in some way at fault. In diabetes there is likewise some defect in the cellular elements of the body—in the protoplasm. In the diabetic glycogen is found in organs in which normally it does not exist, and from this may be inferred a disturbance of the cellular protoplasm. In those cases of diabetes in which the pancreas seems to be responsible the defective activity of this organ gives rise to modification of the cell-protoplasm of the same nature as that which develops under the hereditary impulse. All three affections personally classed as general diseases of protoplasm, hereditarily transmissible. Wilhelm Ebstein (Deut. med. Woch., Nov. 3, '98).

The causes which we have so far mentioned are *predisposing* causes.

As to efficient causes of diabetes, acute infectious diseases cannot be considered in this category, for the affection does not come on after typhoid fever, eruptive fevers, etc. With regard to malaria, several French physicians have noted a temporary glycosuria after attacks of intermittent fever; but in malarial countries true diabetes does not appear to be any more common than elsewhere.

The question of syphilis will be referred to later.

The part played by contagion in diabetes is, so far, not based upon any very exact observations. The occurrence, said to be quite frequent, of diabetes in hus-

band and wife, has been a mooted question.

Man and wife may both be diabetic. From an analysis of 2320 cases, 26 examples of such occurrence have been accumulated. Quite healthy persons, without hereditary predisposition, may become suddenly diabetic after attending to a diabetic for a time, living in the same room, sleeping with and especially kissing him often. In the light of these data, embodying somewhat over 1 per cent. of several thousand cases, the possibility of an infectious nature in diabetes mellitus is strongly suggested. Schmitz (Berliner klin. Woch., May 19, '90).

Twenty-six examples recorded where husband and wife both suffered from diabetes. These were examples chiefly of married females who had become suddenly diabetic after nursing a diabetic husband. There was no indication of hereditary predisposition. No family relationship between the patients, no excess of sugar taken in the food, and the patients had not suffered from gout. The question raised of the possibility of contagion or transmission of the disease.

The numerical relation between diabetic married couples and other diabetic cases is shown in the following table:—

	Married Diabetics.	Total Diabetics.
Betz	1	31
Hertzka	1	86
Lecorché	6	114
Schmitz	26	2320
Seegen	3	938
Külz	10	900
Totals	47	4389

or $1:93\frac{2}{3}$ or 1.08 per cent. B. Oppler and C. Külz (Berliner klin. Woch., Nos. 26 and 27, '96).

Among 770 cases of diabetes observed there have been 9 instances of man and wife suffering from the disease: 1.19 per cent. When all the cases are excluded in which there is a family history of the disease, or a history of any of the well-known etiological antecedents, the cases remaining are so few that it seems probable that the occurrence is accidental,

or that both man and wife have been subjected to the same antecedents. H. Senator (Berliner klin. Woch., July 27, '96).

In a series of 5000 cases 1.8 per cent. of conjugal diabetes found. The facts thus far published do not shed much light on the two theories of causation now held, viz.: (1) that the ordinarily-accepted causes of diabetes are active in both husband and wife, and (2) that the disease is contagious. Cases have been reported with almost conclusive evidence of contagion, but the nature of the contagion and how it is conveyed are mysteries. Schram (Med. News, Jan. 1, '98).

Diabetes considered contagious. Opinion based on cases of conjugal diabetes, as well as on those of persons becoming diabetic as a consequence of daily intercourse with diabetics or handling things made use of by them. M. Ledieu (Gaz. Hebdom. de Méd. et de Chir., Oct. 2, '98).

This coincidence, if it actually is of frequent occurrence, would be an argument in favor of contagion. The question is now being studied.

Nervous affections are certain causes of diabetes. The disease is often met with in people who have suffered from much anxiety or worryment.

Diabetes should be classed among the neuroses; its varied phenomena result by reflexes from the nervous system. The disease obviously arises in the sympathetic chain which controls the secretory functions of the kidneys. J. Blake White (Amer. Medico-Surg. Bull., '95).

Diabetes also occurs very frequently where there has been traumatism of the head. According to certain statistics, 20 per cent. of all cases of diabetes are due to this cause. It is possible that this proportion may be exaggerated, but I am willing to admit that there is surely *one* case of traumatic diabetes in thirty diabetic patients.

The traumatisms most often followed by diabetes are those affecting the head (25 in 45); sometimes also those affecting the vertebral column. Cerebral dis-

turbance mentioned twelve times. Sugar does not always appear in the urine immediately after traumatism; if the diabetes succeeds rapidly to traumatism, it is almost always mild; on the contrary, almost all the uncured cases of traumatic diabetes begin late. Progress is at times rapid; radical cures have been observed fairly often (14 cases out of 45), but they seldom take place where diabetes has persisted more than six months or a year. Bernstein-Kohan (*Thèse de Paris*, '91).

Review of 212 cases of traumatism of the head admitted into the Boston City Hospital within thirteen months. Ranged in five classes: (1) wounds of the scalp; (2) wounds with denudation of the bone; (3) commotion, including cases followed by loss of consciousness, but without fracture; (4) fracture of the vault; (5) fracture of the base. Of the first class there were 84 cases, 5 of which, or 6 per cent., presented glycosuria; in the second class, 43 cases, 4 with glycosuria,—9 per cent.; third class, 40 cases, 1 with glycosuria,—2.5 per cent.; fourth class, 24 cases, 5 with glycosuria,—20.8 per cent.; fifth class, 21 cases, 5 with glycosuria,—23.8 per cent. In all, 20 cases of glycosuria in 212 cases. F. A. Higgins and J. B. Ogden (*Boston Med. and Surg. Jour.*, Feb. 28, '95).

Since the time of Claude Bernard we are aware of the fact that lesions of the floor of the fourth ventricle are particularly liable to give rise to diabetes. Several cases have been observed in man. Lesions in various parts of the encephalon may bring about the same result. It is extremely probable that syphilis is not a cause of diabetes, except through the influence of diffuse lesions of the nerve-centres. There is consequently no syphilitic diabetes, but a diabetes dependent upon cerebral lesions, whether due to syphilis or any other cause.

Out of twenty-seven records of examination of the brain in cases of diabetes mellitus, the organ normal in but five instances, the abnormalities consisting most frequently of oedematous brains

with thickenings of the membranes. Less frequently the organ was anæmic, cystic, particularly in the frontal lobes, in the pons, and in the medulla. Careful examination with the microscope failed to indicate any histological changes, except in one instance where the capillaries of the vagus nucleus seemed to be abnormally numerous and full of blood. Saundby (*Med. Chronicle*, Jan., '90).

Two cases of diabetes, in which changes were found in the spinal cord.

In the first case on naked-eye examination of the spinal cord, after hardening in Müller's fluid, degeneration was found in the posterior columns. This was most marked in the cervical and lumbar enlargements. In the lower cervical and dorsal regions the lesion was confined to Goll's columns; above and below it extended laterally into Burdach's columns. The sacral region was unaffected. In the lower dorsal region the right posterior column was distinctly more markedly affected.

In the second case degeneration of the posterior columns was also found. It was limited to Goll's columns in the upper cervical region. In the lower cervical region it spread to Burdach's columns, and was most extensive in the lower cervical and middle dorsal regions. Below the lumbar enlargement the degeneration ceased.

The spinal changes regarded as the result of the action of some toxic substance in the blood of diabetic patients. Similar changes have been found in the posterior columns of the spinal cord in pernicious anæmia, leucocythæmia, Addison's disease, etc. E. Kalmus (*Zeit. f. klin. Med.*, B. 30, H. 5, 6).

Relationship between diabetes mellitus and epilepsy. Cases in which the diabetes is the cause of the epileptic attacks may be divided into two categories, according as the attacks are due to cerebral lesions or to disturbance in the intra-organic exchange consecutive to the glycosuria. Cases belonging to the former group are rare. In the cases of epilepsy due to diabetes the convulsive spasms are determined by toxic products of intra-organic exchange, and take more

or less the form of coma. The acetonæmic diabetic epilepsy rapidly leads to fatal coma, but when it develops in a chronic and intermittent manner is said to determine epileptic seizures. The cases in which diabetes seems to depend upon epilepsy are divisible into two clinical varieties: those in which the elimination of sugar merely follows the convulsive attack—these have rarely been found; and those in which the glycosuria is a more or less constant accessory symptom of the epilepsy. The cases in which diabetes and epilepsy appear simultaneously are of two kinds: 1. Epilepsy often alternates with diabetes and mental disorders in neuropathic families, and it would, therefore, not be a matter of surprise to find the two conditions present in one person of such a family. 2. There may be a predisposing cause of both in the same subject.

A case belonging to this latter class. The patient had an apoplectic stroke resulting from ischæmia of the left hemisphere due to a cardiac lesion. There was aphasia and pollakiuria, but no polydipsia, polyphagia, nor polyuria. Some months later epileptic seizures, with complete loss of consciousness and convulsions in the previously-paralyzed half of the body, supervened. Ebstein (*Sem. Méd.*, May 22, '96).

Twelve hundred and fifty cases studied in the psychiatric clinic at Leipzig with regard to presence of sugar in the urine, with positive results in thirty cases. The cases were divided into two groups: those of chronic diabetes, which was usually associated with chronic brain disease of the type of dementia, and those of transitory glycosuria, usually associated with acute forms of insanity, particularly of a maniacal type. Often the excitement preceded the appearance of sugar in the urine. Four possibilities may be considered: (1) the glycosuria may be merely an accidental complication of the mental disturbance; (2) diabetes may be the result of insanity, (3) or it may be the cause, (4) or the two conditions may be the result of some common cause. The second sometimes occurs because ex-

cessive emotional disturbances have been known to produce diabetes. R. Laudenheimer (*Berliner klin. Woch.*, May 23, '98).

The pancreas is very frequently found altered in diabetic subjects; sometimes it is simply atrophied, sometimes slightly indurated, and, under the microscope, periglandular sclerotic lesions have been noticed. There are some rare cases in which the tissue of this organ is almost entirely destroyed in consequence of the presence of calculi.

Results of an examination, macroscopical and microscopical, of the pancreas in 23 consecutive cases of diabetes mellitus. In 8 cases the pancreas was found to present a normal appearance both macroscopically and microscopically; and in 4 more there was atrophy, but not more than could be accounted for by the general wasting. In 5 cases there was atrophy more or less marked, and out of proportion to the general wasting; and in one of these the atrophy of the gland was so extreme that the pancreas weighed less than one-fourth ounce. In 4 cases cirrhosis of the pancreas was present, and in 2 of these the changes were marked. In one case cancer of the pancreas was present, and in one the gland had undergone extensive fatty degeneration.

Results of the investigation of 54 cases of diabetes. In 40 of these the pancreas was found to be diseased, and in 36 the lesion was a simple atrophy. In 3 others fibrous induration was present, and in 1 case the pancreas was cystic. In 8 cases out of the 54 the pancreas was normal, and in 6 there was no record as to the state of the gland.

The atrophy of the pancreas in diabetes differs from the simple atrophy accompanying general wasting in the fact that in the diabetic pancreas the stroma of the gland is not only not wasted, but the pancreas shows signs of an interstitial inflammation, and the stroma occupies spaces left by the atrophy of the parenchyma of the gland. Hansemann (*Med. Chronicle*, May, '97).

In 70 per cent. of diabetic patients

some alterations in the pancreas were found. Of special interest in this connection is a lipomatosis of the pancreas, which may exist either in connection with the general excess of fat, or, on the other hand, may be found in lean subjects. Hansemann (*Med. News*, Jan. 22, '98).

Diabetes may appear even when the pancreas is not organically, but only functionally, affected. Zaccharin and Polyakoff (*Berliner klin. Woch.*, vol. xxxv, p. 237, '98).

Pancreatic diabetes is always grave. In view of data recently furnished by experimental pathology, there is no possible doubt as to the pathogenesis of the diabetes in this case: it is evidently due to the suppression of the secretions of the pancreas.

Diabetes never fails to appear after complete removal of the pancreas, if the animals live a sufficient time after the operation. This statement is founded on fifty-five experiments made on dogs. Minkowski (*Berliner klin. Woch.*, 1092, No. 26, '92).

Coincidence of disease of pancreas and diabetes occurs more frequently than diabetes alone or pancreatic disease alone, and oftener than these two combined. Commonest disease of pancreas found in diabetes is an atrophy which differs from atrophy as the result of diabetes or of cachexias; comparable with certain forms of contracted kidney. Hansemann (*Zeit. f. klin. Med.*, B. 26, '95).

Acute diabetes due to cancer of pancreas. Symptoms on admission simulated those of cirrhosis of liver. Dreschfeld (*Med. Chronicle*, Apr., '95).

Extirpation of pancreas of two dogs, leaving $\frac{1}{10}$ to $\frac{1}{5}$ of organ; animals became diabetic: one 4 and the other 13 months after. Sandmeyer (*Zeit. f. Biol.*, B. 31, p. 12, '95).

Eels survived operation of removal of pancreas 7 to 12 days; 7 out of 11 showed no sugar in urine; 2 of them did. Former, perhaps, retained pancreatic remnants. Caparelli (*Archives Italiennes de Biol.*, vol. xxi, p. 390, '95).

Extirpation of pancreas of 19 ducks and 5 carnivorous birds; 4 ducks showed slight glycosuria; 3 carnivorous birds manifestly glycosuric until death. Weintraub (*Archiv f. experimentelle Path. u. Pharm.*, B. 34, p. 308, '95).

The existence of pancreatic diabetes is established, but disease of the pancreas does not necessarily cause diabetes. Of 29 cases from the Massachusetts General Hospital that showed lesions of the pancreas, glycosuria was found in but 2, although in 12 cases there were no records of tests for sugar. Fatty stools are usually absent in cases of diabetes, and there is no record of their occurrence in 166 cases treated in the Massachusetts Hospital. R. H. Fitz (*Yale Med. Jour.*, Mar., '98).

In the cases where the lesion of the pancreas is a minor one (slight induration, slight atrophy, etc.) it is not necessary to regard this slight lesion as the cause of the diabetes, for this disease is often accompanied by a generalized endarteritis,—a cause of sclerosis; or sometimes the diabetic cachexia engenders fatty degenerations. Contrary to the opinion held about half a century ago, experimental physiology has demonstrated that hepatic lesions are not a cause of true diabetes. They may, at most, cause an alimentary glycosuria.

The mild form of diabetes of the fleshy is purely of hepatic origin, the cells of the liver being only affected. In consequence of an anatomical or chemical change, as yet not known, they have lost their glycogenic power. Seegen (*Zeit. f. klin. Med.*, vol. xiii, p. 267, '89).

Theory of Pavy—that in diabetes there is weakening of intestinal epithelium and of liver, which in the normal state prevents entrance into economy of too great quantity of sugar—does not explain most cases. Paton (*Edinburgh Med. Jour.*, Dec., '94).

Extirpation of liver prevents ablation of pancreas to cause diabetes in the dog. Marcuse (*Zeit. f. klin. Med.*, B. 26, p. 225, '94).

A patient, aged 48 years, who, in 1887,

suffered an attack of jaundice lasting six or eight weeks. The following year sugar was discovered in his urine, to the extent of $1\frac{1}{2}$ to 2 per cent. During an annually-repeated "Carlsbad cure" the sugar disappeared from his urine, but after 1892 it was continually present. In 1893 icterus reappeared, and there developed ascites, œdema of the legs, dyspnoea, and wasting. The liver and spleen were much enlarged. Ascitic fluid was withdrawn four times in all. After the last puncture the fluid did again collect. The amount of fluid ingested was at first greater than that eliminated, but eight weeks after the last puncture this relation was reversed. With the excessive excretion of urine the ascites and œdema disappeared. The patient increased in weight and gained strength, the jaundice disappeared, and the liver decreased in size. The patient remained for a long time in good health, then albumin appeared in the urine and œdema of the feet. During the persistence of the ascites the sugar disappeared from the urine, to return again as soon as the ascites was gone. After two and a half years of good health the patient died. The necropsy revealed cirrhosis of the liver with some contraction; tubercles in lung, pleura, and peritoneum; diabetic kidney, and atrophy of the pancreas. Pusinelli (*Berliner klin. Woch.*, No. 33, '96).

Bronzed diabetes is the result, and not the cause, of the accompanying hepatic cirrhosis, which is thought to be due to augmented function of the liver-cells. Gilbert, Castaigne, and Lereboullet (*Gaz. Hebdom. de Méd. et de Chir.*, May 17, 1900).

Pathogenesis.—It would appear, from what has already been stated, that the causes of diabetes are multiple; it is evident that nervous diabetes differs from pancreatic diabetes. In obese diabetic subjects there is usually no appreciable lesion of the pancreas, and certainly no primary lesion. On the other hand, there are no nervous elements in these cases. This is, again, a different type of diabetes, and it would be easy to

multiply the number. As for the immediate cause of diabetes, it is generally complex, consisting most frequently in an increased production of sugar and a diminution of glycolysis. In the light of our present knowledge it would be difficult to say much more upon this point if one wishes to refrain from mere hypotheses.

The pancreas is always the cause of glycosuria. Case of diabetes mellitus in an infant of six months, ascribed to the reflex effect of teething upon the pancreas. Calcium lactophosphate, by assisting the evolution of the teeth, cured the glycosuria. Baumel (*Archives de Méd. des Enfants*, Mar., 1901).

Autopsy of a diabetic negress aged 54 years. The pancreas weighed 80 grammes, was soft and of a gray-yellow color. Almost every island of Langerhans showed microscopically a homogeneous material that stained with eosin. This substance at times lay in the midst of groups of cells, but was usually in contact with the walls of the capillaries penetrating the island, or next the peripheral fibrous tissue, and was therefore usually between the remaining cells and the capillary walls. The cells of the island were in large part replaced, so that between the hyaline particles only an occasional compressed fusiform or irregular nucleus could be seen. The hyaline metamorphosis was strictly limited to the islands of Langerhans, the glandular acini remaining intact. In this pancreas, therefore, a lesion of obscure etiology had destroyed the islands of Langerhans, while those of the secreting acini, as well as those of other organs, were unaffected. The association of diabetes mellitus affords convincing proof that the islands of Langerhans are intimately connected with the glycogenic metabolism. E. L. Opie (*Jour. Exper. Med.*, Mar. 25, 1901).

Duration.—There is so little resemblance between the various cases that an average duration, even supposing that it could be rigorously established, would be of no importance. It suffices to say

that in a general way the average duration of diabetes is several years.

I am consequently much surprised at the results given by Griesinger concerning 100 cases. In 13 the disease only lasted from 6 months to 1 year; in 39, 1 to 2 years; and in 20, 2 to 3 years, which would make the duration of the disease in *three-fourths of the cases* from 6 months to 3 years.

In order to explain such remarkable figures it must be supposed that the diabetes was latent, in the beginning, in a large number of the patients, and that these statistics include a great many serious cases.

The duration in children varies greatly. Out of 34 cases the shortest duration was two days; the longest had not terminated at the end of five years. In 7 cases it did not last one month, and of these 1 was cured. Seventeen lasted less than a year, and of these 7 were cured. Ten lasted over a year, and not one of these recovered, and it may be said that recovery scarcely occurs where the duration is more than one year. C. Stern (*Archiv f. Kinderh.*, B. 11, H. 2, '89).

The main prognostic features are: Age, power of assimilation of carbohydrates, early recognition of the affection, the presence of intercurrent and complicating diseases, condition in life, state of the urine, and the power of absorption of other foodstuffs than carbohydrates. H. S. Starr (*Med. Record*, Apr. 6, 1901).

Termination.—It is evident that diabetes, which is but seldom cured, generally ends in death. In explanation of this rather naive statement, which might lead to a false interpretation, it must be borne in mind that the duration of the disease is a long one, and that in a great number of cases mild diabetes allows the patient to live to an advanced age.

In referring to the complications of the disease, I have already mentioned the frequency of phthisis, and the even

greater prevalence of coma, in diabetics enjoying a certain affluence. To these should be added gangrene, pneumonia, and the numerous complications which may affect the organism when already debilitated by diabetes.

In a certain number of cases, particularly in arthritic subjects, the diabetes may be changed into another malady. Following traumatisms, it may end (after a certain duration of the glycosuria) in simple polyuria.

Principal reasons why diabetes interferes with operative success: 1. The sugar circulation in the blood is hygroscopic, and it draws water from all the tissues of the body until the tissues are actually too dry. This must interfere with the normal process of repair, and it probably does so in several different ways. 2. The surgeon must give these cases special attention, because the fluids of a wound loaded with sugar are, in all probability, excellent culture-media and particularly susceptible to the attacks of bacteria. Rigid asepsis is, therefore, demanded. 3. Certain anæsthetics may precipitate an impending nephritis because of the unusual labor involved in excreting sugar. In these cases nitrous oxide and oxygen used instead of the other anæsthetics, especially avoiding the use of ether. R. T. Morris (*Med. News*, June 29, 1901).

Prognosis.—It may be inferred from the preceding statements that it is difficult to speak of the prognosis of diabetes in general; this can only be established in each individual case.

It may be said, however, that arthritic diabetes and many cases of nervous diabetes are usually not very severe.

In the nervous variety the glycosuria is often quite moderate, and may even disappear, leaving behind a simple polyuria. The type developed under the influence of gout in arthritic subjects is associated with an intermittent, but abundant, glycosuria, and is comparatively benign. Certain diseases of the pancreas, such as calculi of Wirsung's

canal, and sclerosis of the whole parenchyma, may be followed by a rapid and dangerous diabetes. There are other varieties difficult to classify. Lépine (*Sem. Méd.*, Aug. 27, '97).

Deductions based on twenty-two original observations as well as the literature of the subject in respect to the influence of diabetes upon the functions of the female organs of reproduction. In diabetes mellitus menstruation is generally diminished, but not always to a degree parallel to the sugar in the urine. Pregnancy in 66 per cent. is undisturbed, in the remainder is prematurely interrupted, but more often by miscarriage (seven or eight months) than by abortion. The prognosis for the mother is likewise doubtful. Pruritus vulvæ, boils, and acuminate condylomata are well-known diabetic symptoms. Affections of the vaginal mucous membrane and uterine, and necrosis of the ovaries are not so common. Kleinwachter (*Zeitschrift f. G. u. G.*, xxxviii, H. 2, '98).

A relative cure (urine free from sugar on a diet containing 200 grammes of carbohydrate a day) is to be anticipated if at the onset of the disease 80 to 85 per cent. of the carbohydrate consumed is completely burned up in the body. F. Hirschfeld (*Berliner klin. Woch.*, June 18 and 25, 1900).

The progress of a not essentially grave case varies considerably according to the treatment to which it is subjected. It will be much more benign if the patient is intelligent and docile, for there are few chronic diseases in which proper care and attention are as beneficial as in diabetes.

During the period from 1889 to 1899, inclusive, the total number of deaths from diabetes in New York City was 1867. H. Stein (*Jour. Amer. Med. Assoc.*, Jan. 26, 1901).

Treatment.—In my opinion, the treatment of diabetes should not be a systematic one. The first thing to be done, and this is a precept to be applied in the treatment of any disease, is to make a careful study of the patient—to indi-

vidualize him, as it were—to watch attentively the effects of the treatment, and to have no hesitation in modifying the same according to the results. The diet is more important than the medicinal treatment. As in all diabetics the power of assimilating sugar is more or less diminished, it is important to limit the ingestion of hydrocarbon food. The rule is to forbid it as far as possible, and to advise a diet of meat, fish, eggs, green vegetables, particularly those which contain but little starch, also salad, cheese, nuts, etc.

Too great a quantity of meat should be avoided.

In healthy persons submitted to diet from which carbohydrates are absolutely excluded, quantity of acetone increases progressively for seven or eight days, then becomes stationary at from $\frac{1}{3}$ to $\frac{1}{2}$ grain. Diabetes complicated by acetoneuria is rather rapid in its evolution and terminates in death from twelve to twenty months in cases in which there is no gangrene. Treatment: hyperalimentation (carbohydrates in small quantities, albuminoids in not too great abundance, fat, and alcohol); rest. Hirschfeld (*Zeit. f. klin. Med.*, B. 28, H. 1, 2, '95).

Some patients will not thrive on any diabetic treatment. Old people often emaciate if carbohydrates are dropped. In the diabetes of young people carbohydrates must be withheld as much as possible. Under a proteid diet young patients live longer. Patients generally improve on milk. Jacobi (*Boston Med. and Surg. Jour.*, Sept. 9, '97).

The exclusion of carbohydrates can never be complete and many patients do better on a diet not too rigid. The patient should be put on a rigid proteid diet to see what can be accomplished. Then one article after another containing more or less starch or sugar may be added, watching the urine, and finally the diet may be made as liberal as the individual case will permit. Tyson (*Boston Med. and Surg. Jour.*, Sept. 9, '97).

It is of great importance to prescribe definite quantities, and to test the effect of the diet by weekly body-weighing, urine-measurement, and sugar-estimation. Carbohydrates should be excluded as rigidly as possible without damage to the nutrition and general condition of the patient, the case being very carefully watched. Robert Saundby (*Boston Med. and Surg. Jour.*, Sept. 9, '97).

A diabetic should be placed under no different conditions of diet than are granted to the healthy person. Conclusions:—

1. Sugar is always present in the blood.

2. The absence of carbohydrates from the diet does not cause a disappearance of the blood-sugar.

3. The systemic and ingested albumin is capable of furnishing sugar by its decomposition.

4. An increased decomposition of albumin due to the enforcement of a purely-nitrogenous diet means an increased metabolism and consequent loss of body-weight.

5. The administration of carbohydrates retards metabolism.

6. The diabetic has an especial predisposition toward increased metabolism.

7. The diabetic has not lost the power of oxidizing sugar.

8. The abnormal metabolism of albumin results in the production of toxic bodies.

9. The depressed nervous condition of the diabetic is especially favorable for the action of these bodies.

10. The production of toxic bodies is prevented or retarded by the administration of carbohydrates.

The diabetic should live upon a diet which keeps his body-metabolism at its lowest, and for this carbohydrates are necessary. There is no cure for the condition; the treatment must simply be directed to prolong life, and this a rigid proteid diet is not capable of doing. Munson (*Jour. Amer. Med. Assoc.*, May 15, '97).

An absolute diet without vegetables should not be given, as in bad cases it leads surely to more rapid accumulation of acids in the blood, and diabetic coma

is an acid intoxication. Even in the lightest cases, however, for two or three weeks three or four times a year absolutely no carbohydrates should be taken, as thus the metabolic faculty for sugar which has been injured is given that strictly-physiological rest so conducive to its recuperation. Lee (*Med. Record*, May 7, '98).

In diabetes the effort now is to spare the faculty for the absorption of sugar as to lead to its recuperation, and yet not to precipitate a fatal termination by feeding exclusively on albumins and so leading to increased acidity of the blood. For this the sugar-metabolic limits of the organism having been found by a series of urinary examinations, these are never overstepped, a greater quantity of carbohydrates are never allowed than can be consumed, and then three or four times a year, for a period of two or three weeks, the patient is put upon an absolute diet, with all carbohydrates excluded. Leo (*Phila. Med. Jour.*, Mar. 17, '98).

The proper dieting is of the greatest importance in the treatment of diabetes. Drugs have practically no influence on the process. The benefit derived from a stay at some watering-place is ascribed to the diet, which consists exclusively of fat and proteid. In saccharin we possess an excellent substitute for sugar, and one which can be taken for years with impunity. Notwithstanding the many preparations on the market, the proper substitutes for bread have not yet been found, for those which have been tried either become disagreeable to the taste after awhile or they are too rich in carbohydrates. If the condition permits the use of any bread at all, Graham bread is to be preferred. One should never forget that the diabetic needs more actual food than the well, since he loses so much, and underfeeding should be avoided. As with morphine, it is generally better and more agreeable for the patient to withdraw the forbidden articles of food slowly than rapidly. The scales should be used freely to watch the body-weight. If the urine has been free from sugar for several weeks small quantities, say, 25 grammes

($6\frac{3}{4}$ drachms), of bread daily are permitted, and the amount is increased daily 10 grammes ($2\frac{1}{2}$ drachms) till 70 to 100 are reached, which is sufficient for most. As soon as traces of sugar again appear the bread must be reduced in some and in others entirely withdrawn. H. Eichhorst (Therap. Monats., Sept., 1902).

The abuse of the albuminoids by diabetic patients may cause not only the usual disturbances, but it may also increase the sugar in the urine, as Naunyn has justly remarked. It has also been noticed that an exclusively-meat diet may bring about some particular dyscrasia, ending in diabetic coma. This exclusive diet, which was formerly lauded by Cantani, is consequently not to be recommended. It is very difficult to absolutely deprive the patient of bread, so a small quantity, as small as possible, may be allowed, or, in place of this, an equally-small portion of potatoes.

Levulose can be given in moderate quantities in slight forms of diabetes, without injurious results as regards sugar-excretion, urine, etc. Utilized in the system, though dextrose and cane-sugar excreted. Grube (Zeit. f. klin. Med., B. 26, H. 3, 4, '95).

[Levulose may generally be given in small doses to patients suffering from mild diabetes; but, if small daily dose be exceeded, excretion of sugar increased without benefit to patient. R. LÉPINE, Assoc. Ed., Annual, '96.]

In cases of diabetes the addition of a small quantity of alcohol (1 to $2\frac{1}{4}$ ounces *per diem*) has no ill effect. In cases where there is already cardiac weakness or vascular disease, alcohol should be used cautiously. Beer is forbidden, as it contains the most extractive matters, which are chiefly carbohydrates. All sugar-containing liqueurs and sweet wines are, of course, forbidden. Wine, cognac, certain forms of brandy, etc., may be allowed. Hirschfeld (Berliner klin. Woch., Feb. 4, '95).

Eight diabetic patients could completely oxidize levulose in daily amounts

of from 6 to 25 drachms. Levulose not only does not increase, but rather diminishes, the amount of nitrogenous output, both urine and fæces being examined. E. de Renzi and E. Reale (Wiener med. Woch., '97).

There are carbohydrates that seem to have little influence on glycosuria, such as levulose, inulin, and mannite. Certainly the rule is that the group of sugars which deviate polarized light to the left are less injurious than those that deviate it to the right. Bouchard (Sem. Méd., Mar. 26, '97).

Flour made from edible pine-nuts recommended for diabetics. It is fine, slightly yellow, bland in taste, contains no starch, and 7 per cent. of cane-sugar. If raised with yeast, sugar is decomposed so that only a fraction of 1 per cent. can be found. Bread and cake made from it are relished, and it is an agreeable substitute for wheat-bread. The flour is known as the "Chicago Sanitary Flour." N. S. Davis, Jr. (Jour. Amer. Med. Assoc., Nov. 5, '98).

Strict milk diet in diabetes combined with hydrotherapeutics, systematic exercises, fresh air, and sunshine advocated. Winternitz and Strasser (Centralb. f. innere Med., Nov. 11, '99).

Diabetics must be taught to use fats in abundance. They are the only substances that can succeed in stilling the craving for the starches and sugars and can properly replace them. Editorial (Med. News, Feb. 17, 1900).

Thirty-four different kinds of potatoes subjected to examination, the most notable result of the proceeding being that the potatoes employed for diabetic feeding should be fresh and mature, and that the central portion of the tuber, being the most watery, the richest in nitrogenous matters, and the poorest in starchy ingredients, is the best suited for the purpose. A. Mosse (Klinisch-therap. Woch., Oct. 7, 1900).

Ebstein has recently very highly recommended aleuronat bread, which contains a much greater proportion of vegetable albumin than any other thus far recommended for diabetics, and which may consequently be taken in larger

quantities. With regard to drinks, the abuse of beer, alcohol, and wine should be forbidden.

The above are the main features in the diet; it is necessary to conform to them as far as possible, at the same time avoiding all exaggerations.

Sugar-free milk contains approximately 3 per cent. of proteid and 5 per cent. of fat. If 3 pints are taken in a day, the food-value amounts to 990 calories, or nearly one-third of the total amount required, while the amount of fat which the patient obtains is equivalent to fully 3 ounces of butter. In cases in which a small amount of carbohydrate is desirable, it is sometimes best to substitute sugar-free milk, and give carbohydrates in the form of potatoes or bread, as this enables the patient to ingest a larger amount of fat. Robert Hutchison (*Lancet*, June 22, 1901).

In the severe forms of diabetes, the diet must naturally be much more limited, except in cases where coma appears imminent. The marked reaction of the urine with the perchloride of iron, and especially the diminution of the appetite, are the chief premonitory symptoms of this danger. In such cases every one is agreed that it is well to abolish the restricted diet.

Opium is of temporary service, at least, but I have never found it beneficial for any length of time. It causes a reduction in the quantity of sugar. Villemin advised the addition of belladonna. I have never been able to convince myself of the advantage of its use, and have found it to cause dryness of the throat. Antipyrine is sometimes most useful; it frequently diminishes excessive polyuria and reduces the sugar.

The value of antipyrine in three cases of long standing (one of twenty years') verified. The results were immediate, and all traces of the condition promptly disappeared—in one case permanently, in another for a long time after a with-

drawal of the remedy; in the third case the quantity of urine at once rose to its former amount upon the withdrawal of antipyrine, but upon readministration fell again. Beginning the treatment, the medicament should be given to the amount of 31 grains, *per diem*, this amount increased by $15\frac{1}{2}$ grains daily until $1\frac{1}{2}$ drachms are reached or the amount of urine diminished; and after eight days should be omitted in order to see if the results are permanent. Opitz (*Deut. med.-Zeit.*, Aug. 8, '89).

Antipyrine tried with the object of diminishing the amount of sugar, uric acid, and urea, but the diminution only fleeting. Beer-yeast of no use. Pancreas in the fresh state in daily doses of 30 grammes given with no better success. The corner-stone of treatment in diabetes is diet. Mousse (*La Sem. Méd.*, Aug. 19, '96).

Antipyrine is not always indicated, however. It is only used in certain cases of diabetes, probably those in which the hyperproduction of sugar is very great, for my researches have shown that it tends rather to counteract the destruction of the sugar; moreover, the use of antipyrine cannot be long continued. Salicylate of soda has also been of service; its action is similar to that of antipyrine, with the exception that it does not equally diminish the polyuria. Quinine acts in the same way as the antipyrine and the salicylate of soda, and has the advantage of being tonic.

Sodium salicylate, as recommended by Ebstein, used in twenty patients. Diet and regimen being the same, it seemed in large doses—75 to 80 grains daily—to have a marked effect in diminishing the amount of sugar in the urine. Stopping of the drug would cause the sugar to reappear, to disappear on resuming the medication. R. T. Williamson (*Brit. Med. Jour.*, Mar. 30, 1901).

Ebstein's plan of treating diabetes by large doses of salol tried in nine cases. Three severe cases showed no improvement, but the other six, moderately se-

vere cases, were markedly benefited. In the latter, strict diet caused the sugar to disappear; but the improvement was very gradual. Salol, on the other hand, caused the sugar to fall at once. Although the drug was administered in 15-grain doses, four times a day, for five days, no case showed gastric disturbances or tinnitus. The action does not seem to last long, as the sugar gradually reappeared after the drug was stopped. Teschemacher (*Therap. Monats.*, Jan., 1901).

Jambul is also recommended; but in many cases it fails completely. Its mode of action requires to be further studied.

In the treatment of glycosuria, using the rind instead of the fruit in the preparation of the extract of jambul makes it more agreeable in taste and much cheaper than the fruit. As much as 1½ ounces per day can be administered for a long period without disagreeable effects. It is best given in water or wine. Vix (*Ther. Monats.*, Apr., '93).

Eugenia jambolana is almost a specific in diabetes, best given in syrup or juice of ripe fruit mixed with water to form a sherbet. The powdered seeds or a fluid extract of the seeds is an exceedingly valuable form in which to exhibit it. Rudolf (*Bull. of Pharm.*, Jan., '98).

For a number of years, particularly in fatty diabetes, I have been using permanganate of potassium: an agent which increases the oxidation. I use a 5-per-cent. solution, the patient taking 2 or 3 teaspoonfuls, or even more, per day.

Fourteen patients treated with forms of calcium, generally as phosphate and carbonate. This treatment has apparently no effect upon the excretion of sugar, but the patient feels better and increases in weight. Of these patients three were young subjects who were markedly benefited. Upon the others there was no result. The treatment, however, produced no detriment. Karl Grube (*Ther. Monats.*, H. 5, S. 258, '96).

The effects of uranium nitrate are (1) to diminish the thirst, (2) to reduce the amount of urine passed, and (3) to re-

duce the percentage of sugar. Like all the other drugs used in the treatment of diabetes, uranium nitrate does not influence all cases alike favorably. Samuel West (*Ther. Gaz.*, Sept., '97).

Hepatic extract, prepared as follows, should be given daily per rectum: 3½ to 5¼ ounces of fresh pigs' liver are minced in a machine and macerated for 2 hours in 7 to 9 ounces of water at 95° to 100° F., then filtered through muslin and expressed. This amount is usually well borne as an enema; if it is not, divided doses must be given. The cases of diabetes which derive the most benefit from the treatment are those of definite hepatic origin. If the hepatic cell is too diseased, the treatment fails. Summing up 12 cases, 3 were benefited temporarily, 5 were improved permanently, and in 4 the glycosuria ceased completely. It is interesting to note that in most cases urea and uric acid are increased while liver is taken.

One deduction is certain: that the extract lessens the excretion of glucose; whether by increasing the power of storing up reserves of sugar, or by causing a more rapid destruction of ingested hydrocarbons, remains uncertain. The antitoxic function of the liver is little, if at all,—the biliary but slightly,—while the glycogenic and uropoietic functions are markedly increased. Gilbert and Carnot (*La Sem. Méd.*, May 10, '97).

1. In diabetes mellitus there is a distinct loss of phosphorus, lime, and chlorine by every form of diet.

2. Addition to diet of phosphate of lime induces a slight saving of nitrogen; addition of salt does not do this.

3. Addition of fatty matter produces the same effect as phosphate of lime.

4. Addition of phosphate of lime to the diet causes diminished excretion of sugar. W. v. Moraczewski (*Zeit. f. klin. Med.*, B. xxxiv, H. 1, 2, '98).

In diabetes, Fowler's solution and co-deine give best results, together with tonics, such as muriatic acid, strychnine, and quinine, as indicated. H. G. Norton (*Med. News*, July 9, '98).

Arsenous acid in doses as large as ⅓ grain a day recommended in diabetes.

In cases of progressive emaciation a mixture of 100 grammes of glycerin and 2 grammes of tartaric acid with some rum, added to a quart of water, is very useful. Jaccoud (*Méd. Mod.*, No. 14, '98).

Methylene-blue used in two cases of diabetes mellitus, in average doses of 5 grains daily. In one case, after treatment for five weeks, subjective symptoms were relieved, and glucose reduced to mere trace. In second case, in which urine contained about one ounce of sugar per quart, the saccharin content was reduced to $1\frac{1}{4}$ drachms per quart after treatment for four weeks. Estay (*Bull. Gén. de Thé.*, No. 2, '98).

Where aperients fail in diabetes, cocaine in small doses ($\frac{1}{8}$ -grain doses twice or thrice daily) will not only brace up the muscular system generally and remove the sense of fatigue so frequently present in these patients, but overcomes constipation. Thomas Oliver (*Lancet*, Aug. 13, '98).

Eulexine used with great satisfaction in diabetes. E. C. Skinner (*Louisville Med. Monthly*, Oct., '98).

Diabetes believed to be due to ptomaine poisoning or to bacterial invasion of the organism. Therefore mercuric chloride has been used in beginning doses of $\frac{1}{12}$ grain three times daily, increasing within a week to $\frac{1}{6}$ grain. Three weeks of this treatment are sufficient to cause a marked reduction in the amount of sugar and improvement in the general health. After this time the dose is decreased to $\frac{1}{4}$ grain in the day. Abraham Mayer (*Med. Record*, Dec. 10, '98).

Cases in which the administration of liver-substance brings about improvement are those in which the diabetes is connected with a functional inadequacy of the liver (characterized by diminution of urea, urobilinuria, etc.). On the other hand, cases of diabetes that are not benefited or are even made worse by the treatment are those in which the glycosuria appears to depend on overactivity of the organ. Gilbert (*Inter. Congress of Med.*; *Brit. Med. Jour.*, Oct. 13, 1900).

Opium, arsenic, and bichloride of mercury are the drugs of most service. Opium, which is of the greatest general

use in controlling various annoying symptoms, should not be used continually, but interruptedly. It should be given in small doses (not more than $\frac{1}{2}$ grain three times a day at first), and its constipating effect should be counteracted by cascara sagrada or other laxative. There are certain cases of diabetes, generally occurring in middle age, which were like a bacterial invasion or ptomaine poisoning. In these the bichloride of mercury has a certain, perhaps specific, value. The dose, at first small, should be increased to $\frac{1}{6}$ grain. Even if the sugar is not entirely eliminated, many patients can get along very comfortably for years. The diabetic's attention should be diverted as much as possible from himself, and he should be free from professional or business cares and other sources of worry. He should wear warm clothing and avoid fatigue and all excesses. Massage and carbonic-acid baths are often of great service, and visits to various health resorts, with the use of mineral waters to aid digestion, have a good effect. About 25 per cent. of diabetics die from phthisis. Abraham Mayer (*Boston Med. and Surg. Jour.*, Apr. 18, 1901).

Alkaline waters perceptibly diminish the sugar in the urine. Their use should consequently not be restricted, unless the patient be very much debilitated. Vichy water, taken at the springs, is particularly recommended for fatty diabetics.

Carlsbad water also appears to be useful.

For diabetic patients who are already somewhat cachectic, Bourboule water, which contains considerable arsenic, is preferable.

If the kidneys are inactive, Contrexéville should be recommended.

Independently of the use of mineral waters, it is better not to neglect baths.

Hydrotherapy may be advised for diabetic patients who are still young and, as a rule, lotions of cold salt water in summer, and warm baths followed by friction

in winter. At Aix warm douches and massage are resorted to. Generally speaking, massage is always useful for patients whose weak condition does not allow of prolonged muscular exercise. Active movements, if they do not fatigue the patient, are preferable to the passive movements. Warm climates have a favorable influence; when the patients are not greatly debilitated, mountain-air has also been recommended.

Physicians are sometimes consulted as to the advisability of allowing the use of saccharin in diabetes, to replace the taste of sugar.

I have not seen any bad effects following the use of saccharin when employed in *small doses*. An equal quantity of bicarbonate of soda should be added.

In *diabetic coma* the following intravenous injection should be used:—

R Chloride of sodium, 1 drachm.

Bicarbonate of sodium, $2\frac{1}{2}$ drachms.

Distilled water, 1 quart.

A strict milk diet should be instituted at once, and the elimination of poisons should be assisted by the administration of saline purgatives. Should the heart be feeble or irregular, full doses of digitalis and ergotine are to be given.

Results of observation on treatment of diabetic coma by subcutaneous or intravenous injections of bicarbonate and chloride of sodium. 1. Alkaline injections have given incontestable results in diabetic coma. 2. These injections are best intravenous, the subcutaneous method being too slow. 3. If possible, intervention should precede coma, as Lépine points out. When the patient shows progressive aggravation, a feeble pulse, lowered urine, slow respiration, with increasing dyspnoea, nausea, and vomiting, an intravenous alkaline infusion of from 300 to 375 grains of bicarbonate of sodium with $112\frac{1}{2}$ grains of chloride of sodium to 1000 parts of water

is indicated. M. A. Berson (Jour. des Sci. Méd. de Lille, Aug. 6, '98).

Nineteen cases of diabetic coma treated by saline injections, mostly published in Germany and England, collected; of these only one, a case of Lépine's, recovered from the coma; but few or none appeared to have received such copious injections. Roget and Balvay (Lyon Méd., Jan. 8 and 15, '99).

If there is any reason to fear coma, an energetic use of alkalies should be prescribed. In these circumstances an hypodermic injection of strychnine must be given, and $\frac{1}{2}$ ounce of soda bicarbonate should be administered as an enema in hot water, and repeated every hour until improvement takes place. Saundby (Practitioner, July, 1900).

Good results follow the prophylactic administration of sodium bicarbonate: 15 to 30 grains daily. In the fully developed diabetic coma it has proved a failure. The use of calcium carbonate has been productive of good results. H. Stern (Jour. Amer. Med. Assoc., Dec. 8, 1900).

R. LÉPINE,
Lyons.

DIARRHŒA. See INTESTINES, DISORDERS OF.

DIARRHŒA, INFANTILE. See INFANTILE DIARRHŒA and CHOLERA INFANTUM.

DIGITALIS.—Digitalis is indigenous to Great Britain, Ireland, and many parts of Europe, where it grows wild on gravelly or sandy soils in young plantations, at hedge-sides, and in hill-pastures. It has been introduced into America, but is more grown as an ornament to gardens and in hot-houses than for commercial purposes, and, moreover, it is claimed that it is not so active medicinally as that obtained abroad. *Digitalis purpurea* is the official plant, though some pharmacopœias take cognizance of other forms, notably *D. Am-*

bigua, Murr., which was extensively exploited by Paschkis a few years ago; and all seem to possess much the same general activity, though purple digitalis alone has been at all carefully studied.

The *Digitalis purpurea*, which is the source of all our medicinal preparations, is a biennial or perennial with numerous drooping, purple-spotted (occasionally white) or purple flowers, an erect stem from twelve to fifty inches high, and large alternate, ovate, lanceolate, crenate, rugose leaves of downy character, especially on their pale- or light- reddish-brown under-surfaces, and tapering into winged roof-stalks. The leaves, which constitute the official digitalis, should be of the second year's growth—when they are much more oval, and also more active than those of the first year—and gathered either in July or late in June, before the small, round, gray-brown seeds begin to ripen, and when about two-thirds of the flowers have expanded; they should also be dried in the dark, in baskets, over a moderately-heated stove or in a brick oven, and if properly cured will exhibit a dark-green hue and an almost total lack of odor, except that which generally accrues to dried herbs and leaves and frequently is described as “tea-like”; they have a decided nauseous and bitter taste. Much of the uncertainty that accrues to the medicinal use of digitalis is doubtless due to improper seasons of plucking, improper drying or packing, and age; for even the best qualities and most carefully collected and husbanded, even when pressed and wrapped in stout paper, or kept in tins that are not hermetically sealed, manifest distinct loss of remedial virtues after a few months, and may become practically inert at the expiration of a year. Digitalis-leaves, too, as found in open market, more espe-

cially the cheaper varieties, are probably not of *D. purpurea*; or the latter may be adulterated with leaves of the common potato, the black nightshade or black mullein (*Solanum tuberosum*, *S. nigrum*, and *Verbascum nigrum*) or all three, or *Coniza squamosa*, which, in a dry state, somewhat resemble those of the purple fox-glove. Such sophistication, however, may be detected by boiling one of the suspected leaves in the smallest possible quantity of water, pouring upon an opalescent plate, and adding a drop of ferric chloride: if a green reaction occurs, the leaf is digitalis; if blue, it is not.

Preparations and Doses.—Digitalis-leaves, powdered, $\frac{1}{2}$ to 3 grains.

Digitalis abstract, $\frac{1}{2}$ to 1 grain (Squibb's, 2 to 5 grains).

Digitalis infusion (B. P.), 1 to 4 drachms (U. S. P., 2 to 8 drachms).

Digitalis extract, solid, $\frac{1}{6}$ to $\frac{1}{2}$ grain.

Digitalis, fluid extract and normal liquid, 1 to 2 minims.

Digitalis tincture (B. P.), 5 to 40 minims.

Digitalis tincture (U. S. P.), 3 to 30 minims.

Digitalis, ethereal tincture, 2 to 8 minims.

Digitalis-vinegar (G. P. digitalis, 1; alcohol, 1; vinegar, 9 parts), 10 to 30 minims.

Digitalisin (concentration), $\frac{1}{16}$ to $\frac{1}{4}$ grain.

Digitaléin (Schmiedeberg's), $\frac{1}{64}$ to $\frac{1}{32}$ grain.

Digitaléine (Nativelle's). See DIGITONIN.

Digitalin (U. S. P. and B. P.), obsolete.

Digitalin (Homollis & Quevenne's “French Codex”), $\frac{1}{80}$ to $\frac{1}{15}$ grain.

Digitalin (Schmiedeberg's, or digitalin verum, Kiliani), $\frac{1}{64}$ to $\frac{1}{32}$ grain.

Digitaline (Nativelle's), $\frac{1}{250}$ to $\frac{1}{60}$ grain.

Digitonin (Nativelle's digitaléine), not employed.

Digitoxin (Schmiedeberg's), $\frac{1}{250}$ to $\frac{1}{125}$ grain.

DIGITALIS ABSTRACT.—This is merely a dried solid extract powdered and mixed with some material to prevent its subsequent firm agglutination, and should be made without heat by the substitute process. It presents a green color and the characteristic digitalic odor. Within a few days after making and placing in a bottle, the powder contracts very much and adheres in a fairly-solid mass that is, however, easily broken up by means of a stiff spatula, and then readily rubbed to powder again. The abstracts in market, however, vary in strength and are obsolescent.

The solid extract possesses the same odor, somewhat intensified, as the abstract, and properly made is of so dark green a hue when seen in mass as to be nearly black; but, when thinly spread, the green is very marked and intense. A brownish solid extract is suspicious and suggestive of too much heat employed in manufacture, in which case it is apt to prove inert.

INFUSION.—The infusion requires to be made with great caution and from carefully-selected leaves of bright color and distinctive odor, also without undue heat. That of the U. S. P. is only about half the strength prescribed by the B. P.: a fact that is to be taken into account according to the residence or locality of prescriber or patient. *Fresh leaves* are nearly one-third more active than the infusion.

When an infusion of digitalis is given to individuals with normal circulatory

apparatus in quantities equal to that administered to persons with valvular disease, there is no increase in the blood-pressure nor in the quantity of urine excreted, while the reverse is true of persons who have heart disease. Ernst von Czyhlarg (Wiener klin. Rund., Apr. 15, 1900).

FLUID EXTRACT.—A good fluid extract should represent a definite amount of drug, viz.: one gramme of leaves to the cubic centimetre of fluid. So called "normal liquid" is merely a fluid extract containing the regulation amount of drug which is also proved by assay to exhibit a uniform proportion of digitalin (total glucosides).

TINCTURES.—"Concentrated" and "specific" tinctures should have the same strength as the fluid extract.

The tinctures of the B. P. and U. S. P. vary slightly: the former exhibits a strength of 3 to 24, respectively, of bruised leaves and proof-spirit; the latter 3 to 20, of drug and dilute alcohol.

The ethereal tincture is twice the strength of the U. S. P. alcoholic tincture.

Owing to the rapid deterioration of digitalis-leaves after curing, the most reliable preparations are those obtained from responsible homœopathic and eclectic pharmacists, both being in duty bound to employ the fresh leaves of the uncultivated plant in its second season when about to bloom. The homœopathic pharmacist chops and pounds the leaves to a pulp, incloses in a piece of new linen, subjects to pressure, and mixes the expressed juice by brisk agitation with an equal amount, by weight, of alcohol, the whole being then allowed to stand for eight days in a well-stoppered bottle in a dark, cool place, after which it is filtered. The eclectic macerates eight ounces of fresh leaves in a pint of alcohol (76°).

Active fluid preparations of digitalis do not lose in activity by being made into tablets, nor do the tablets become less active by keeping than do other preparations of digitalis. E. M. Houghton (Ther. Gaz., No. 4, p. 217, '98).

DIGITALIN.—Digitalin, as it formerly appeared in the pharmacopœias, is now obsolete, and where the same was used as the title of a concentration it is now replaced by digitalisin. The latter is a very uncertain production as regards strength, and consequently should not be employed.

VINEGAR.—Vinegar of digitalis, which still retains a place in some Continental pharmacopœias, offers no advantages over other fluid preparations, and consequently has been dropped by the British and U. S. authorities.

LINIMENT.—Digitalis-liniment is merely a mixture of equal quantities of official tincture of digitalis and soap-liniment.

ointment and POUltICE.—Digitalis ointment may be made with any desirable fat and of any required strength, the usual proportions are 1 to 9 of solid extract and base, respectively. Digitalis poultice may take the form of a fomentation of the leaves, or be made by adding an ounce of the tincture to a linseed poultice.

ACTIVE PRINCIPLES.—The so-called active principles consist of a number of glucosides: digitalin, digitalein, digitonin, digitin, and digitoxin. Unfortunately, great confusion exists regarding these preparations, which has been fostered by pharmacopœial errors. Thus the digitalin of Homolle & Quevenne, recognized by French authority, is an amorphous, yellowish-white powder, inodorous, intensely bitter to taste, extremely irritating to the nostrils, and highly poisonous; it is sometimes found as small scales. It is chemically a mix-

ture of the digitalin of the German pharmacopœia and the digitoxin of Schmiedeberg. Another form that has the sanction also of the French Codex is *digitaline* (mark the final *e*) *cristallisée*, or the digitaléine of Nativelle, and appears as white, crystalline tufts or needles, and consists almost wholly of Schmiedeberg's digitoxin; it is very bitter to taste, slowly eliminated and consequently cumulative in action, and dispensed only when "crystallized digitalin" is ordered. Both the foregoing are insoluble in water or ether, but the crystallized form yields readily to chloroform and rectified spirit.

The digitalin of the German Pharmacopœia is also the digitalin verum of Kiliani. It is a white or yellowish, amorphous product, consisting of digitalein and digitoxin (Schmiedeberg's); is soluble in water, 1 to 1000 in alcohol; almost insoluble in chloroform and ether.

Digitalein (Schmiedeberg) is also an amorphous, yellowish-white powder of intense bitter taste; soluble in water and alcohol, slightly so in chloroform and ether; as before remarked, this is the chief constituent of German digitalin.

DIGITOXIN.—The digitoxin glucoside of Schmiedeberg is the most poisonous of all the digitalis principles and likewise markedly cumulative in action, owing to the difficulty with which it is eliminated. It occurs as a white, crystallized powder, soluble in chloroform and alcohol, slightly soluble in ether, insoluble in water.

DIGITONIN.—Soluble in water and alcohol, appears in the form of yellow granules, but possesses none of the properties for which digitalis is celebrated. It appears to be identical, or at least closely related, to saponin, the active principle of quillia bark.

DIGITIN.—Digitin is a coarsely-granulated, crystalline powder, soluble in alcohol, ether, and alkaline solutions, and is physiologically and therapeutically inert.

DIGITALIRESIN.—Digitaliresin and digitoxiresin purport to be derivatives, respectively, of the digitalin and digitoxin of Schmiedeberg, but beyond this nothing is known of either.

A comparative study of digitalis and its derivatives shows that: 1. Digitalis and digitoxin each represent the full circulatory powers of digitalis. 2. Digitalis, digitalin, and digitoxin stimulate the cardio-inhibitory mechanism both centrally and peripherally. In larger doses they paralyze the intrinsic cardio-inhibitory apparatus. 3. They all cause a rise of blood-pressure by stimulating the heart and constricting the blood-vessels. 4. Very large doses paralyze the heart-muscle of the mammal, the organ stopping in diastole. 5. Digitalin of Merck is a stable compound, 1 gramme of it being equivalent to about 70 cubic centimetres of tincture of digitalis. 6. Digitoxin is not to be recommended for human medication on account of its irritant action, which makes it liable to upset the stomach when given by the mouth, or to cause abscess when given hypodermically, and on account of its insolubility, which renders it slowly absorbed and irregularly eliminated, having a marked tendency to cumulative action. Arnold and Wood (*Amer. Jour. of Med. Sciences*, Aug., 1900).

Digitalis as obtained from various regions shows entirely regular alterations at different periods of the year. These alterations are always in direct association with certain definite periods of the year, the general result being that the old leaves found toward the beginning of August have customarily only about one-fourth the activity of the new leaves. D. Focke (*Zeits. f. klin. Med.*, vol. xlv, Nos. 5 and 6, 1902).

When digitoxin is employed, it is recommended that a solution be made in alcohol, chloroform, and water, and that it be administered by clyster: digitoxin,

$\frac{1}{96}$ to $\frac{1}{64}$ grain; chloroform, 4 minims; 90-degree alcohol, 1 drachm; water, to make 14 drachms; at one dose.

Physiological Action.—Though digitalis *per se* has been before the medical profession for more than three centuries, the fact remains that its physiological attributes are by no means thoroughly understood; indeed, they constitute a subject on which there is great difference of opinion. It may be affirmed that experiments upon mammals, birds, and batrachians have added practically nothing to the knowledge already possessed regarding the action of digitalis when introduced into the economy of man. Part of the trouble may have arisen from the fact that many of the preparations as found in shops are practically inert, while the different dosage and forms of exhibition as employed by different observers inhibit uniformity. The action on the two-chambered heart of the frog, or three-chambered heart of the bird, both of which animals excrete solid urea, cannot coincide with that on the four-chambered heart and the fluid-excreting renal gland of the mammal, while, as is well known, there are few drugs toward which individual members of the human family are so generally and differently idiosyncratic. Again, the actions of watery and alcoholic preparations are by no means identical, owing to the differences in the solubility of the various glucosides in these *menstrua*; an infusion, for instance, holds in solution chiefly the digitonin, while the tincture contains digitalin and digitalein,—neither contains much digitoxin, but the tincture necessarily carries more than the infusion. Notably the infusion is more directly and promptly diuretic, and the B. P. tincture more so than that of the U. S. P., but the latter two afford the best results when the heart alone is

to be acted on. But it is doubtful if the tincture alone ever acts as a true diuretic, except in the presence of a heart-lesion, such as is found in connection with some form of hydrops. The drug often fails completely in securing the desired action clinically, because the wrong preparation is employed, and it may here be noted that little reliance is to be put on the glucosides, at least not until we are possessed of more definite knowledge regarding their composition and physiological relations. Not only is their use to be deprecated, but they are generally dangerous and sometimes remedially worthless. Digitoxin especially is so highly toxic and so difficult of elimination as properly to bar it from official recognition. How often is seen the statement that digitalis is a powerful sedative, and again that it is a heart-stimulant? This conveys little information, because it is conflicting; yet it may be true, and depends solely upon the dosage, and the peculiarities of the individual patient. In fact, there is no drug in the materia medica that requires more careful handling or more careful study of effects in each and every one for whom it is prescribed; and again there is no drug more certain in securing definite results, when intelligently exhibited.

Regarding action on heart and circulation, it is deemed best to give in abstract the various views:—

Wood sums up the action of the drug by saying that in moderate doses it stimulates the muscular portion of the heart (probably of its ganglia), increases activity of the inhibitory apparatus, and produces contraction of the arterioles. As a consequence of the first action, the cardiac beats become stronger; as a result of the last, there is narrowing of the blood-paths, and to the passage of the

vital fluid an increased resistance which, acting on the already-excited inhibitory system, aids in slowing the pulse. Decided therapeutic doses produce great reduction and sometimes diastolic tension of the pulse, and increase the size and force of the wave; at the same time the arterial tension is augmented.

Murrell states that the greatest and characteristic action of the drug is that it affects elasticity of cardiac muscle without at first modifying its contractile power, as indicated by increase in the volume of the pulse, although the absolute working power of the heart is neither increased nor decreased; at the same time the quantity of blood driven into the aorta is greater than before, not only at every beat of the pulse, but even in a given unit of time; notwithstanding the number of pulsations be diminished, the result is a better filling of the arteries and an increase in blood-pressure. Accompanying this condition there is slowing of the pulse due to stimulation of the inhibitory mechanism of the heart. Finally, in conjunction with continuous high pressure there is irregularity both in the action of the heart and in the frequency of the pulse. Digitalis does not exert a sedative action on the muscular substance of the heart; and although the organ may be beating more slowly it may also be doing more work.

Ringer and Sainsbury teach that digitalis undoubtedly does affect directly—*i.e.*, immediately—the muscular tissue of the heart, including persistent contraction. Inasmuch as this action on the heart is independent of the agency of nervous tissues, it seems presumable that it may affect other muscular tissue in the same way. It does undoubtedly cause strong contraction of the blood-vessels when these are quite cut off from the central nervous control; hence it must act

either directly on the muscular tissue of the walls of blood-vessels or on some peripheral nervous apparatus that governs the muscular tissue of the blood-vessels. In therapeutic use it may be conceived that digitalis will act in different ways: by strengthening the action of a weak heart; by reducing the strength of the beats of a heart acting too powerfully; by lessening the frequency of the heart's beats; by correcting irregular action of the organ; by increasing tonicity and so lessening the size of the cavities, thereby obviating the condition of over-distension in which the stretched ventricles are unable to contract upon the contents, a condition threatening complete asystole—the second of these propositions a different and fuller dosage will probably be required.

It has been the general view that each preparation is capable of producing effects peculiar in some respects to itself. But the physiological effects of digitalin and digitoxin are identical with those of digitalis, except that they do not stimulate the vasomotor centre or the pneumogastric apparatus, and so do not directly raise blood-pressure or slow the heart. In other words, they increase the force of ventricular contraction. The effect of digitonin is to depress the vagus nerves, so it antagonizes the vagal effect of the digitalin and prevents digitalis from slowing the heart to the extent that would result from the use of digitalin alone. It also depresses the heart-muscle. H. A. Hare (*Therap. Gaz.*, Aug. 16, '97).

Attention called to the vasomotor action of digitalis; with a rather generous dose, migraine due to cerebral congestion can be overcome, where a small dose, acting on the circulatory centre, would simply aggravate the condition. Diuresis is produced only in those cases in which there is anasarca, and is due to anasarca; often there is diuresis without increase of blood-pressure. When the dropsy has disappeared the diuresis ceases. Diminution of the dose is indi-

cated on the disappearance of dropsy. Chief indications of digitalis are increased frequency and irregularity of the pulse and the presence of oedema. In cases the reverse of these it is useless or harmful. Warning is given against its careless use in myocarditis with fatty degeneration and in cardiac asthenia with dilatation. In cardiac dilatation of gastric origin digitalis is harmful, for it is not tolerated by the stomach. Arteriosclerosis is not a contra-indication if caution is used. Where increased frequency of the pulse or dropsy are present in aortic insufficiency, digitalis is distinctly indicated. The same is true in mitral stenosis. In mitral insufficiency it has its widest use, but it is late in the disease that digitalis is most needed. When tricuspid accompanies mitral insufficiency, the former, unless great care be taken, is made to disappear too rapidly by digitalis, and pulmonary apoplexy results, through increase of capillary pressure. Of the preparations, digitalin is preferable. M. Potani (*Jour. de Méd.*, '98).

The chemical composition of digitalis is complex, some of its active principles antagonizing others; the various preparations of digitalis differ widely in their composition and action; the so-called cumulative action of digitalis is due to its contracting the arterioles and shutting off nutrition; it is both a useful and a dangerous remedy, and has a very limited range of usefulness; it is of use only in lesions of the mitral valve, and then only for a short time, and should be discontinued as soon as these have been overcome; it is of value as a diuretic only when there are low arterial tension and engorgement of the kidney. Digitalis decreases the excretory action of the normal kidney and impairs its nutritive activity. The tincture of digitalis, made from the fresh leaves, is the most valuable and the most certain of the preparations of digitalis. It contains the largest percentage of those constituents which are most useful in the treatment of cardiac disease. W. H. Porter (*Amer. Medicine*, Apr. 27, 1900).

Investigations carried on in the Pharmacological Institute in Heidelberg, and

based on experiments on cats with different pure preparations of digitalis, the influence of each drug being continued for a period of several weeks. All digitalis preparations were used in gradually increased doses. At first a simple therapeutic action occurred, which finally became cumulative. Digitoxin exhibited the strongest cumulative action, and is, therefore, not to be recommended for continued daily use. Digitalicum, on the other hand, is rapidly excreted, and may be used in certain cases for considerable periods. Strophanthin is usually more evanescent in its action than digitalis, but a preparation of strophanthin recently prepared by Professor Thoms, of Berlin, is particularly active and lasting. In none of the preparations was there observed any tendency to become habituated to the drug. Frankel (Amer. Medicine, May 31, 1902).

ACTION ON BRAIN AND CORD.—It is now generally held that digitalis, in therapeutic doses, has little effect upon either the brain or the spinal cord, but earlier writers laid great stress upon its "mildly-irritant" properties as regards both, and that as it became cumulative it tended to "confuse the mental faculties." There are some observers who, to this day, ascribe the antithermic action of the drug to an effect upon the cord, whereas it becomes an antipyretic solely by its influence upon the circulation. In pyrexias there is partial vasomotor paralysis with dilated arterioles, low blood-pressure, and increased tissue-change in and around the dilated terminal vessels; consequently by contracting these vessels digitalis raises blood-pressure, it being well understood that, as the latter takes place, the temperature falls, and *vice versa*. In other words, there is always an antagonism between temperature and blood-pressure.

While ordinary doses do not affect the brain, as the drug becomes cumulative, or it is pushed to a point approaching

toxicity, the reflexes of the spinal cord seem to be somewhat lessened. As before shown, under ordinary dosage, there is probably some stimulation of the vasomotor and pneumogastric nerves.

ACTION ON URINARY APPARATUS.—Under certain conditions digitalis seems to increase the flow of urine without altering, in any essential respect, the quantity or proportion of its solid ingredients; but, strange to say, this action is seldom manifested in the healthy human subject, though it is apt to be very pronounced when there is an accumulation of fluid to be removed. In truth, the manifestations of digitalis are often inconsistent and varying as regards renal secretion, and are probably in great measure indirect and secondary. As before intimated, the infusion is the most reliable form to exhibit for such purpose, and doubtless here the watery menstruum should receive a due portion of credit. That the drug is, in any sense, adenagic or a stimulant to glandular tissue, and consequently diuretic because of such action, receives little credence these days. A fairly free use of alcoholics in connection with the infusion seems to enhance the activity of digitalis as regards the kidneys, but a better method is to combine with the latter a minute portion of cantharides.

Digitalis has no pronounced constant effect upon nitrogenous elimination. Alexëvsky (St. Peter., Inaug. Diss., '90).

The drug increases the consumption of the chlorides, sulphates, and phosphates. Beljakow (Schmidt's Jahrb., B. 219, '91).

Digitalis increases the amount of solids eliminated in the urine, except urea and uric acid, which are diminished under its use. Biddle ("Mat. Med. and Therap.," '95).

Conclusions regarding physiological and therapeutic actions of digitalis and of its active principles summarized as follows: 1. The physiological action of

digitalis is exerted chiefly (*a*) on the heart, (*b*) on the blood-vessels, and (*c*) on the secretion of urine. 2. Its action on the heart is that it (*a*) slows the cardiac beats chiefly by stimulation of the roots of the vagus in mammals, (*b*) increases the force of systole, and (*c*) increases the extent of expansion in diastole. Both *b* and *c* are due to an action on the cardiac muscle. 3. It contracts the peripheral vessels, and thus slows the current of blood through them. 4. By its combined action of contracting the peripheral vessels and of increasing the power of the heart it raises the blood-pressure. 5. The diuresis which digitalis produces is chiefly due to increase of blood-pressure. 6. Digitalis contracts the arterioles in the kidney sooner than those in other parts of the body. The renal vessels may contract so much as to arrest the secretion of urine altogether, although the general blood-pressure is high. 7. When blood-pressure is already high, digitalis cannot be expected to have a powerful diuretic action; but if the blood-pressure be low, from natural constitution or disease, digitalis will have a diuretic action. 8. Digitalis is a local anæsthetic, but also produces pain. It therefore belongs to the class termed by Liebreich "anæsthetical dolorosa." 9. In large or in accumulated doses it gives rise to gastric irritation. 10. The action of digitalis is due to digitalin, digitalein, and digitoxin. These principles all have an action similar in kind, but differing in degree. 11. The therapeutic actions of digitalis and of its active principles are that they (*a*) regulate the heart's action, (*b*) assist a failing circulation, and (*c*) act as diuretics. 12. The regulating action of digitalis is useful in palpitation and functional disturbances of rhythm. 13. The most important use of digitalis and of its active principles is in the treatment of mitral incompetence due either to disease of the valves or dilatation of the ventricle. 14. In cases of aortic regurgitation digitalis is (*a*) unnecessary and not without danger when compensation is complete, but (*b*) very useful when compensation fails. 15. When the blood-pressure is already high, digitalis may be injurious by increasing

it still farther, and thus causing symptoms of angina pectoris or tending to produce apoplexy. T. Lauder Brunton (Inter. Med. Congress; Brit. Med. Jour., Sept. 29, 1900).

As a diuretic, digitoxin is superior to digitalin, since it actually dilates the renal vessels, while stimulating the heart. Furthermore, its action is prompter and more certain than that of digitalin. It manifests its effects oftentimes within twelve hours, and is less liable to cumulative action than digitalin. Masius has used as much as $\frac{1}{40}$ grain a day. After discontinuing the use of the drug the influence of digitoxin is said to persist, sometimes, for eight to ten days. To avoid digestive disturbance, Wenzel employed it chiefly by enema, giving about $\frac{1}{80}$ grain in 10 minims of alcohol and 4 ounces of water. The action upon the heart, as observed in these experiments, was quite pronounced; at first three rectal injections were given daily (previous thorough cleansing of the bowel being presupposed), afterward only two injections were used, and, finally, only one was found necessary, in order to maintain the first effect produced. In personal experience digitoxin has been given in a series of cases—of late, chiefly hypodermically, but also by the mouth (*always after meals*). It was the exception to see any digestive disturbance when $\frac{1}{600}$ grain or less of digitoxin was being given three times daily. In no case did an abscess ever result from the hypodermic syringe.

Digitoxin has been especially recommended in chronic myocarditis and in cases of ruptured compensation.

A solution of digitoxin is liable to precipitate on coming in contact with the secretions of the body. To avoid this, and yet not use too much alcohol in the pharmaceutical preparation of the solution, it has been recommended to add a little chloroform to the solution. The following solution has, after experimentation, been found to be stable, and will not precipitate upon contact with blood-serum, water, or sodium-chloride solution:—

R Digitoxin, $\frac{1}{250}$ grain.
 Chloroform, $1\frac{1}{2}$ minims.
 Alcohol at 90 per cent., 23 minims.
 Water, sufficient to make $\frac{1}{2}$ ounce.—M.

L. L. Solomon (N. Y. Med. Jour., Feb. 9, 1901).

ACTION AS AN ANTIPYRETIC.—Why toxic doses cause a fall of temperature, even in health, is one of the physiological problems that yet awaits solution; and with this depressed temperature muscular paralysis is apt to supervene.

ACTION ON UTERUS.—The muscular substance of the uterus is powerfully contracted by digitalis. It was long supposed that this action was the result of stimulation of uterine ganglia, but it is now believed to be due to the affinity of the drug for unstriated muscular fibre. In uterine hæmorrhage, when administered, the patient (usually in about ten minutes) complains of very severe pain in the region of the sacrum, which passes into the hypogastrium, and in every respect seems to resemble the pain of the first stage of labor; very shortly afterward a considerable quantity of blood, generally in part coagulated, is forced out from the womb.

As digitalis has been employed somewhat extensively and successfully in simple menorrhagia, its affinity for the reproductive apparatus of the female seems well established; some authors go so far even as to accredit it with phenomenal emmenagogic properties, though the evidence adduced appears to be of rather a hazy and uncertain character; and yet digitalis is employed as an ecbotic or abortifacient in some European countries.

Incompatibles.—Digitalis is incompatible in fluid preparations with salts of iron and lead; likewise with tannin and all vegetable solutions containing them. Therapeutically it is antagonized

by aconite and its alkaloid, by scoparine, muscarine, saponin, staphisagria and the alkaloid of the latter, delphinine, and by drugs of the belladonna group.

Digitalis Poisoning.—Digitalis poisoning is of extremely rare occurrence: a fact that may be, oftener than not, perhaps, ascribed to the practically-inert character of most of the preparations marketed. The symptoms are, for the most part, the same as when too large or too-long-continued doses have been exhibited, but in greatly-aggravated degree: disordered state of *primæ viæ*; slow and irregular pulse; coldness of extremities; syncope or tendency thereto; giddiness; confusion of vision, external objects appearing of yellow or green hue, mist or sparks before eyes, which are prominent, with pupils fixed and perhaps dilated; weight and pain in forehead; weakness of limbs; insomnia; stupor or delirium; urine suppressed, perhaps; there may be abundant salivation. Fatality is usually preceded by stupor or convulsions and a dilated, insensible pupil.

According to Tardieu, an almost diagnostic symptom of digitalis poisoning is a blue color of the sclerotic.

The minimum fatal dose of digitalis is not known, and, owing to the inconsistency of its action, probably never will be. The treatment after evacuating stomach and bowels should be tannin, opium, stimulants, and recumbent posture; aconite may be employed, but it requires to be administered with caution.

Treatment of digitalis poisoning must be symptomatic. The administration of the drug is to be stopped; the alimentary canal is to be cleared of any impurities it may contain; elimination must be increased by diluents; sickness allayed; arterial tension reduced when high; sleep procured if necessary, and other symptoms treated as they arise.

Nitroglycerin is the best remedy for the reduction of arterial tension. If the blood-pressure is low, alcohol will prove of great service. Taylor and Marshall (Brit. Med. Jour., Nov. 4, '99).

After the drug had been administered to a woman of 40 for six weeks (5 drops of the tincture every four hours), symptoms of profound mental disturbance appeared. At first simulating mere hysterical excitement, the disorder rapidly developed into a violent mania. The drug was immediately discontinued, and she recovered promptly. A. W. Dunning (St. Paul Med. Jour., May, 1902).

In spite of a vast amount of evidence adduced in favor of medicinal use of the glucosides of digitalis, the fact remains that all are uncertain bodies, and that no one definitely represents the therapeutic activity of the drug itself. They are practically worthless in heart diseases. Even for hypodermic use tincture of digitalis is preferable and it is less irritating. In any event, the only glucosides worthy of attention are the digitaléine of Nativelle, or *d. cristallisée*, and the digitoxin of Schmiedeberg; even these are highly irritant to the skin and likely to produce eczematous and other eruptions that are also often, as well, results of the use of digitalis ointments or poultices.

Some nocturnal delirium is one of the first bad results of digitalis. Pallor, coldness of the extremities, trembling, and contraction of the pupils are important indications to suspend the drug. Some patients die suddenly of syncope, others gradually. Death from digitalis is most frequently met with in Bright's disease, arthritic and anæmic subjects, and in persons with aortic incompetence or delirium tremens. Occasionally there is melancholia and night-terrors. An unusual result is pulmonary apoplexy. Potain (Jour. de Méd., Apr. 10, 1900).

Therapeutics.—Digitalis is one of the most abused drugs of the materia medica.

One of the most universal abuses is the habit of prescribing it for a patient without advising him to abstain from exercise while under its influence. There are very few physicians who have not been disappointed by its results from the counteracting influence of exercise. All patients taking digitalis should live in perfect physical and mental quietude, as otherwise there is danger of adding to the perils of the diseased conditions demanding its use. English (Med. and Surg. Rep., Aug. 22, '96).

In disease, rest in bed and a regular diet will alone cause diuresis in 60 per cent. of cases in from 2 to 5 days. The ureal excretion is similarly increased. In 26 cardiac cases treated by digitalis an increase in excretion of solids and fluids took place in 22 cases, and the best results were obtained from the tincture, 15 minims every four hours, or from Nativelle's granules, one three times per day. Out of 13 cases in which strophanthus was used, 8 showed diuretic effects, though not so marked as from digitalis, and much more disagreeable gastrointestinal symptoms followed. Diuretin increased the urine in 6 out of 12 cases, its advantage being the rapidity of its action, but its toxic symptoms were more marked than digitalis and its effect less prolonged. In Bright's disease, however, it acts more favorably than digitalis or strophanthus. In cardiac dropsy digitalis is the drug *par excellence*. J. A. MacCaren (Med. Chron., Sept., 1900).

DISEASES OF THE HEART.—Digitalis is, above all, a cardiac remedy; but there is as much dispute over the classes of cases to which it is applicable as over its physiological action.

A fact that is not only forgotten, but frequently ignored, is that in normal conditions the heart-muscle adjusts itself to the demands made upon it. In those whose vocations force them into the extremes of bodily exertion, the heart becomes muscular in proportion to the demands. In response to temporary or protracted influences that perturb the heart and induce overexercise without diminution of tonicity of the myocardium, as in functional or reflex disor-

ders, the same result follows. Digitalis is often administered under these circumstances to steady or quiet the cardiac tumult; this is a flagrant abuse of a good medicine and an unpardonable sin against the heart, and is but an added goad to an already overworked organ. Moreover, if the stomach, whence the disturbing impulses often proceed, is already irritated, the presence of digitalis will augment the difficulties in geometric ratio by increasing nausea and heightening the cephalalgia and other symptoms of gastric distress. Cardiac arrhythmia of myopathic origin, or reflex, toxic, or nervous in its nature, cannot present a reasonable cause for employing digitalis. If it be exhibited in palpitation due to neurotic conditions, there will be a possibility of converting the curable disorder into an incurable malady.

In aortic regurgitation it is sometimes employed in a thoughtless and careless manner. It is a dangerous medicine and often harmful in this valvular malady. If the diastole is increased and prolonged, the period of regurgitation and its force are augmented, and the difficulties multiply.

The only excuse for prescribing it in aortic stenosis is to give vigor to the myocardium when the tendency to dilatation is pronounced. If it slows the action of the heart notably, it may add to the valvular systole or occasion tetanic contraction.

It is deplorable to employ it in conditions of compensation. Many a case of benign hypertrophy has thus been goaded into myocardial weariness and weakness that disabled the heart from keeping up its work. In the absence of dropsy, in all cases where the urine is voided freely, there is little, if any, call for digitalis. English (*Med. and Surg. Rep.*, Aug. 22, '96).

In pediatric practice digitalis is indicated in cardiac disease whenever the muscular contractions become of insufficient strength. It is especially valuable in mitral disease, but is contra-indicated in aortic insufficiency until the pulse becomes rapid and irregular. It is useful for its diuretic action in respiratory disease, like hydrothorax and pleurisy, and

for its effect upon the heart in pneumonia, severe bronchitis, and influenza. In repeated severe hæmoptysis it is of value. In acute infectious diseases it is valuable if given before the myocardium has undergone marked degeneration. It should never be given for a longer period than 7 or 8 consecutive days, and then its use must be suspended for from 8 to 10 days. Comby (*Revue Inter. de Méd.*, etc., vol. ix, No. 11, '99).

Digitalis is especially indicated in simple dilatation. It is not contra-indicated except in the advanced stages of myocardial degeneration. Huchard (*Méd. Mod.*, Feb. 17, 1900).

Insufficient attention is paid to the selection of suitable patients for digitalis. When inequality, irregularity, and insufficiency of the pulsations are absent, or when there is no dropsy of the cellular tissues and serous cavities, contra-indication for digitalis exists. A permanently infrequent pulse is not a contra-indication. A strong contra-indication to digitalis is the presence of myocardial lesions. Thus myocarditis, senile cachexia, fatty degeneration, etc., call for the very greatest care in the use of this drug. Aortic incompetence is, generally speaking, a contra-indication. Dyspepsia very often causes digitalis to disagree. A cachectic condition is a contra-indication. Potain (*Jour. de Méd.*, Apr. 10, 1900).

Case of a man who had valvular defect of the heart. He improved on digitalis, and after passing from medical observation continued to employ this drug. This failed to control the condition, and the patient died. The doses that were employed toward the latter part of his life were enormous. It was estimated that in the course of five years he consumed between 500 and 600 grammes ($16\frac{1}{3}$ and $19\frac{2}{3}$ ounces) of the drug. C. Schubert (*Münchener med. Wochen.*, Sept. 23, 1902).

In arteritis digitalis is a powerful auxiliary, assisting to control the morbidly increased action of the heart and arteries, but it should not be used to the exclusion of general antiphlogistic measures.

It is generally said that digitalis does harm in aortic regurgitation, and good in obstructive mitral disease; but it is better to rely on symptoms rather than on the nature of the valvular lesions as indications for the administration of the drug. A rough-and-ready rule, which works well in practice, is that digitalis can be given when the pulse is irregular or intermittent and the urine scanty. Remember that the freshly-prepared infusion is a better preparation than the tincture. Murrell, Lond. ("Manual of Mat. Med. and Therap.," '96).

Some consider digitalis is beneficial in mitral obstruction, while others hold it is indicated more especially in mitral regurgitation. It has been observed of eminent service in cases where, after death, the symptoms were seen to be due to mitral regurgitation, and little, if at all, to mitral obstruction. One should try digitalis in every mitral case, even in pure mitral stenosis. Inefficiency may be due to irregularity arising from fatty degeneration; and the indications for its use are less conspicuous in aortic disease with insufficient compensation than in purely mitral cases, though in failing heart from aortic disease it may render excellent service. In irritable heart where much hypertrophy exists, digitalis may prove serviceable, and may totally fail to afford any relief. It is often valuable in quelling attacks of palpitation. It is useful in fatty heart and arterio-capillary fibroses inducing hypertrophy of left ventricle. Ringer and Sainsbury ("Hand-book of Therap.," '97).

ANEURISM AND ATHEROMA.—A number of writers have lauded the use of digitalis in aneurisms and in general capillary atheroma, with a view, as stated, of "quieting the circulation." Such, however, must be considered as open to severe censure, since increased blood-pressure may, in the one case, tear open the thin wall of the aneurismal sac, and in the other rupture an atheromatous cerebral capillary.

Aneurism and decided atheroma of vessels contra-indicate the use of digi-

tal. Stevens ("Manual of Therap.," '94).

Recommended to steady and reduce heart's action. T. Holmes ("Quain's Dic. of Med.," vol. i, '94).

If there be increased resistance to the circulation in aneurism or in general capillary atheroma, and the heart has not sufficient power to meet this, digitalis may be useful, but must be employed with extreme caution. H. C. Wood ("Princ. and Prac. of Therap.," '94).

Contra-indicated because it increases intra-arterial pressure. Roth ("Modern Mat. Med. and Therap.," '95).

Digitalis is contra-indicated in aneurism and all diseases accompanied by high tension, and where there are changes in cardiac muscle or atheroma of blood-vessels, except for temporary use in emergency. Foster ("Prac. Therap.," vol. i, '96).

The best remedy in aneurism is digitalis given in increasing doses until the pulse comes down to 50 or 45. It should be continued as long as possible. Clifford Allbutt ("Prac. of Med."); Farquharson ("Therap. and Mat. Med.," '89); Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

DROPSY; HYDROCEPHALUS.—In the dropsy of visceral disease and in the serous accumulations of inflammatory origin digitalis is often of service, but preferably it should be used in connection with some other diuretic, such as broom or squill; a minute portion of cantharides added to digitalis infusion insures a satisfactory diuretic effect. But the best results invariably accrue to administrations in the dropsy of cardiac disease and subacute nephritis. In the United States the remedy has never been employed with the same freedom as abroad; and in England and Scotland patients were formerly—and even yet in some districts—fairly drenched with an infusion made with "two handfuls" of leaves, drank *ad libitum* until ultimate narcosis, vomiting, and purging oc-

curred. The quantity that may be given without danger is sometimes surprising, but the character of the malady in which it is exhibited should be taken into account. For instance, so satisfactory has it generally proved, in large doses, in the treatment of hydrocephalus, that many of the older practitioners to-day deem it a specific.

NERVOUS DISEASES.—Although no direct action is produced on brain-tissue by digitalis, it may be imagined some alteration in cerebral function may follow changes induced in the vascular system; hence the apparent benefit oftentimes experienced from the empirical employment of the drug in various forms of mental alienation and in epilepsy. For nearly a century the remedy has been considered in Germany as an almost specific in mania.

In epilepsy, though it has produced no cure, it is evident that the use of digitalis ought not to be too hastily forsaken. In mania it is often exhibited with good effect. Barton (*"Cullen's Treatise on Mat. Med.,"* vol. ii, '12).

The use of digitalis should be limited to those cases where the malady is dependent upon disease of the heart and particularly where there is increased fullness and pulsation of carotids and temporal arteries. Foville (*Waring's "Prac. Therap.,"* '95).

Careful examination of literature reveals opinions about equally balanced as to good or ill effects of digitalis in epilepsy; it may, therefore, be concluded that the subject demands more careful and detailed attention than has hitherto been given it. In many cases detailed it is evident that the dose employed was too small to be productive of benefit; in many more the drug, at best, was only palliative. In the north of Ireland where the drug still obtains a reputation as a specific, the doses employed are very large.

DISEASES OF KIDNEYS.—In the treatment of albuminuria digitalis has found many advocates; but, as will be readily understood on recalling its physiological relations, it cannot be held a remedy for what is at best but a mere symptom, except its activity is directed toward the primary lesion, and that referable indisputably to the central organ of circulation; and even here it should be employed only most watchfully and cautiously. Where the kidneys are involved with any morbid process having its inception in the cardiac apparatus, individual susceptibility and idiosyncrasy are likely to be highly developed. In acute stage of Bright's disease digitalis poultice and dry cupping often afford relief; and the infusion may also be employed in $\frac{1}{2}$ -ounce doses, repeated every two hours for twenty-four hours, or as long as uræmic symptoms are urgent. The drug should be promptly discontinued once the urine begins to flow, and diuresis continued with the aid of mild, diluent beverages. In passive renal congestion, too, which is generally associated with cardiac disease, digitalis may be indicated.

Digital is of service in granular degeneration of kidney by increasing the quantity of urine passed and lessening the amount of solids voided. It is also of service in relieving the tension of renal capillaries. Webster (*"Dynamical Therap.,"* '93).

Because it is claimed that digitalis is a drug which increases the force of the heart and contracts the vessels of the periphery—except those of the kidneys—it is employed indiscriminately as an ideal diuretic in Bright's disease, notwithstanding the contra-indications observable in capillary tension and cordy pulse. Such irrational therapeutics can result in naught but harm. It seems almost foolhardy to use it in chronic nephritis accompanied with high peripheral blood-pressure, as it usually is,

unless preceded by a short course of nitroglycerin to relieve the peripheral tension. English (Med. and Surg. Rep., Aug. 22, '96).

Decidedly beneficial in chronic form of Bright's disease, where there is cardiac dilatation. In early stage of the malady, accompanied by cardiac hypertrophy and high arterial tension, it is doubtful if digitalis is indicated, either alone or in combination. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

URINARY CALCULI, ETC.—Digitalis, from its effect primarily upon the circulation, and secondarily upon the renal organs, is often a valuable adjunct to antilithic remedies. It is not itself in any sense a solvent of gravel or calculi, nor is there any evidence of remarkable power in mitigating pain or otherwise alleviating the symptoms that accompany maladies of this class; but Barton nearly a century since noted that the drug, in many instances, in a most remarkable manner relieves the troublesome dysuria which is dependent upon stone or gravel.

CARDIALGIA.—Here, though often recommended in doses from 10 to 20 minims three or four times daily, little can be generally expected, though by its action on the heart it may alleviate pain contingent upon some cardiac disorder.

DYSPNŒA; ASTHMA.—In the treatment of maladies of this class, too, the drug has found a place, but in uncomplicated forms it is inferior, both as to safety and efficacy, to other drugs. Where these are connected with disease of the heart or functional palpitation, relief may be afforded, and when accomplished the digitalis should be withdrawn, since now either opium or henbane, or both, will better answer the purpose. In spasmodic asthma it is occasionally serviceable, and it was very extensively employed in the latter part

of the last and beginning of this century.

PHTHISIS.—Fifty years ago the remedy—like pretty nearly everything else at some time during its therapeutic life—was regarded as a panacea for phthisis; it was even declared that by means of fox-glove it was as possible to arrest pulmonary inflammation with as much certainty as an intermittent could be by means of cinchona or cinchonol derivatives. It is now, however, very rationally rejected as a cure, and merits only to be regarded as one of the many means occasionally useful in this malady, and which may sometimes assist more important measures. In hæmoptysis, as in other hæmorrhages, it is sometimes of great service.

PNEUMONIA.—In pneumonia, however, digitalis is often distinctively of the utmost value, particularly in maintaining the heart's action where there is adynamia, and for the promotion of the excretion of waste through the kidneys. Another fact not generally noted is that many cases of pneumonia result fatally, not from the pulmonary congestion, but from uræmic poisoning; this fact is entirely lost sight of because the attention of the practitioner is generally absorbed by the primary lesion. (Sajous.)

Series of eight hundred and twenty-five cases of pneumonia treated with infusion of digitalis:—

R Digitalis-leaves, 60 to 90 grains.

Water, 52 drachms.

Simple syrup, 12 drachms.—M.

A tablespoonful every half-hour. This continued for two or three days aborts the disease and reduces the mortality to 2.06 per cent. Petresco (Trans. XI Internat. Med. Cong., '94).

[Huchard states that Roumanian digitalis may possess properties varying greatly from that of other countries. Ed.]

The effect on the pulse and temperature is slight, and, in view of the dangerous nature of the remedy, it is not worth the risk. Lowenthal (Centralb. f. d. Gesam. Therap., '94).

The remedy *par excellence*. Recoveries will and do occur in greater numbers when treated by large and persistent doses of digitalis. Paulison (Med. Age, Sept. 10, '94).

Seventy-four cases of croupous and thirty-four of lobar pneumonia treated with large doses of digitalis most satisfactorily. Only one death: that from lobar pneumonia. Fickl (Wiener med. Woch.; Med. Age, Oct. 10, '94).

Twenty-one adults and thirteen children suffering from catarrhal pneumonia treated with large doses of strong infusion of digitalis. The adults bore the doses well, but the children frequently exhibited evidence of gastro-intestinal disturbance. Favorable results in eighteen cases. Ordinary or small doses of digitalis have no influence upon the pulse or upon the progress of acute pulmonary disease. Strong infusions are harmless, and have very favorable influence upon the process of the disease, and may even cut it short if administered at the onset. Contra-indicated in children of one year and under, and in old people. Bloch (Wratsch, Nos. 15, 16, '94).

Often of great value in various acute diseases, such as adynamic pneumonia and adynamic fevers, by maintaining the heart's action. It can have no effect upon the diseases themselves, but may help most opportunely to sustain the heart during a crisis or a period of strain upon it. H. C. Wood ("Princ. and Prac. of Therap.," '94).

In congestion of the lungs with high fever it is often a valuable remedy in relieving venous stasis. In the second stage of pneumonia it is of the greatest importance, being of use here to stimulate the contractile force of the cardiac muscle when the intraventricular pressure becomes stronger than the unaided muscle can resist, and dilatation is imminent, if not already begun. The main indication for the drug is the increase

in intensity of the second pulmonic sound. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

If the patient is strong, under 40, with no concomitant organic disease, preference must be given to the treatment by baths; under opposite conditions, especially when the heart is feeble, digitalis should be given in doses of 45 and 85 grains of the powdered leaves a day, exhibiting it every two hours infused in water with the addition of rum and syrup of orange-peel. Slight vomiting and vertigo are not contra-indications, but the treatment must be continued till the pulse becomes abnormally slow or irregular. It is doubtful whether the enormous doses given by Petrescu are free from risk, and whether the artificial lowering of temperature by them is of real value. The maximum dose should not exceed 45 grains daily of the powdered leaves. Barth (La Sem. Méd., July 22, '96).

PLEURISY.—That digitalis may be a remedy of value in pleurisy where there is effusion, goes without saying, but some believe it is indicated at even an earlier period, on the theory that it combats hyperæmia. This, after all, is only an indorsement of the practices of Sir Thomas Watson, Aitken, and Niemeyer, who all held that the drug was especially adapted to the pre-exudative stage; and, even a quarter of a century back, the view that the drug is anti-phlogistic and adenagic had by no means become obsolete.

EXOPHTHALMIC GOITRE.—Digitalis has also been employed in exophthalmic goitre occasionally with considerable success.

Cases of exophthalmic goitre in young subjects, purely functional in character, have been cured by digitalein; and the cardiac irregularities and dilatation of the cervical vessels ameliorated even in incurable cases. Cawasjee ("Prac. Vade Mec.," Bombay, '91).

In exophthalmic goitre it sometimes quiets the heart and lessens the pulse-

rate. Stevens ("Manual of Therap.," '94).

Digitalis occasionally proves efficient as a heart-tonic in exophthalmic goitre. Biddle ("Mat. Med. and Therap.," '95).

Patients with Graves's disease may improve under a long course of the drug, but generally this treatment fails. Hale White, Lond. ("Mat. Med., Pharm., and Therap.," '95).

ALCOHOLISM AND DELIRIUM TREMENS.—Enormous doses of digitalis are often tolerated by alcoholics, and especially those suffering with delirium tremens, probably "because the heart has by long habit become very much benumbed to the use of stimulants."

Digitalis is wonderfully effective, particularly where there is low arterial pressure. Is undoubtedly less serviceable in delirium tremens characterized by high arterial tension. Butler ("Text-book of Mat. Med., Therap., and Pharm.," '96).

Seventy cases were treated by the late Mr. Jones, of Jersey, without the production of any alarming symptoms; but other observers were not so fortunate, and in two instances the patients fell back dead, although up to that moment there had been nothing to indicate serious danger. It must be remembered that, if a patient dies suddenly when taking digitalis, the death is always attributed to the treatment; whereas if any other drug were given the result would probably be attributed to the disease. Murrell ("Manual of Mat. Med. and Therap.," '96).

The following conclusions appear to be established: That digitalis may be given in large doses in delirium tremens without danger. That it very often does good, producing speedily, in most cases, refreshing, quiet sleep, and even when it fails it will generally calm undue excitement. That some cases appear to be uninfluenced by the drug, though there yet remains to be ascertained the forms of the disease that are most amenable thereto. Under this treatment some severe asthenic cases, in which, owing to the great prostration present, death

seemed imminent, have rallied astonishingly, and ultimately recovered; the evidence of this is too strong to be disputed. Under the influence of digitalis the weak, rapid, and fluttering pulse has grown steady and strong, the skin has become comfortably moist and warm, and, simultaneously with the improvement in the circulation and state of the skin, the general condition of the patient has improved. On the other hand, personal experience in many instances has evidenced that sthenic forms of the disease are also amenable to the drug. Ringer and Sainsbury ("Hand-book of Therap.," '97).

AS AN ANAPHRODISIAC.—It has been remarked that the drug is held to be anaphrodisiac; but it is likewise accredited with aphrodisiac properties. If the supposition is true that digitalis has a direct affinity for the genital plexus, it may act either way according to dose and method of administration; it may also, in the same way, render the tissues involved either anæmic or hyperæmic. Hence it has been used in spermatorrhœa and gonorrhœa, for its effect on the minute blood-vessels of the tissues and its supposed anaphrodisiac properties.

It is a serviceable anaphrodisiac in spermatorrhœa, in conjunction with cold bathing of genitals. Foster ("Prac. Therap.," vol. i, '96).

Few remedies are of more avail in arresting spermatorrhœa than digitalis in 1-drachm or 2-drachm doses of the infusion, twice or thrice daily. Ringer and Sainsbury ("Hand-book of Therap.," '97).

FEBRILE MALADIES.—Every few years there appears to be an attempt to rehabilitate digitalis as an antithermic and antipyretic, and a wonderful amount of evidence favorable thereto is elaborated. The general application of the drug in this direction has been attended with many fatalities, and many more have occurred that have never found

record, owing to the ignorance of the prescriber and friends of the patient. The writer saw, during one summer, three fatalities that could be traced directly to the maladministration of digitalis given as an antipyretic in mild cases of intermittent and remittent fever. In typhus and typhoid the agent has been most lauded, but all the evidence adduced in its favor will not excuse the practitioner who employs empirically only.

HERNIA.—The writers of the early part of the century were wont to recommend the use of this drug in very large doses for the reduction of incarcerated hernia. Thirty years ago appeared in the *Lancet*, London, a statement that if suppuration of a gland have begun, digitalis would prevent the formation of abscess. This is undoubtedly true in many instances, owing to promotion of increased absorption and elimination.

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DILATATION OF THE HEART.

Definition.—Increase in the size of the heart, due to enlargement of one or more of its cavities. Clinically, "dilatation" is applied to an enlarged, but failing, heart displaying the phenomena of "ruptured compensation."

Varieties.—"Simple" dilatation is the term used to denote that condition in which the walls of the heart remain of comparatively normal thickness. Inasmuch, however, as the cavities, and consequently their walls, are more extensive than normal, simple dilatation is associated with a certain amount of hypertrophy. Dilatation is "hypertrophic" when the heart-walls are thicker than normal. Another name is "active" dilatation; and viewed from the opposite stand-point it becomes "eccentric hyper-

trophy." In "atrophic," or "passive," dilatation the walls are thinner than normal.

Most cases of dilatation are essentially chronic in their development and progress. Some, however, are acute.

Symptoms.—Usually the earliest indication to the patient of his trouble is shortness of breath. This at first is apparent only upon exertion, but in well-developed cases it becomes a source of great suffering. Hardly more than one word can be uttered without a pause for breath; and sleep, if obtained at all, is possible only in the vertical position (orthopnoea). The ordinary automatic respiration has sometimes to be supplemented by voluntary efforts; so that when sleep does come the dyspnoea becomes aggravated and soon wakes the patient.

Another early symptom is palpitation with a sense of discomfort or oppression in the cardiac region. It is singular that the powerful heave of an hypertrophied heart does not seem to obtrude itself upon the consciousness of the patient so much as the feeble flutter of dilatation. There may also be a cough, with white, frothy, serous expectoration. The poor circulation in the brain is evidenced by more or less mental slowness and easy fatigue, with impaired memory, despondency, ill-temper, and attacks of faintness. In the digestive tract the passive congestion of the stomach is evidenced by fermentation, heaviness, nausea, and even vomiting. The bowels are usually sluggish, and the urine is scanty and high-colored, with a deposit of urates.

In mild degrees of dilatation the complexion is pale, in more advanced cases dusky or cyanotic with blue lips and finger-nails. The extremities are apt to be cold to the touch, and the sluggishness of the capillary circulation is illus-

trated by the slow return of color to any point of the surface after firm pressure: the shape of the examiner's hand is, as it were, stenciled upon the cyanotic surface. The labored breathing is noticed even while the patient is at rest, but becomes striking upon the least exertion. Edema invades first the ankles, thence creeps upward to the thighs and puerenda, and finally invades even the face and arms. Ascites and hydrothorax are often present. It is not unusual to find a considerable amount of fluid in one side of the chest, while the other presents merely the signs of oedema. The eyes are somewhat prominent and glassy. Frequently the liver is much enlarged, reaching even to the level of the navel. This change in its size may be more or less obscured by the ascites present, but in that case can often be demonstrated by a quick, though gentle, pressure of the fingers inward (*ballotement*). In some cases the spleen is also found to be enlarged.

Cardiac dilatation, to a moderate extent, is far from uncommon in early life; indeed, in childhood the heart may be said to dilate with especial ease. The dilatation may be found out apart from any valvular affection; it is due to blood-pressure in a flabby, ill-nourished, or degenerated heart, and may occur without there being any resistance to the passage of blood from the heart. Acute infections, such as broncho-pneumonia, diphtheria, and acute rheumatism are particularly liable to cause this. In any such case of acute disease where the dilatation is rapid, a recumbent position should be enforced, and on no pretense should the patient be allowed to lift even his head from the pillow. The diet should be regulated so that those foods that tend to ferment and fill the stomach with wind should be forbidden; baked apples, grapes, oranges, and acid fruits are to be avoided. The patient should be fed with milk, custards, strong soups, yolk of egg, and rusk. In the

matter of drugs, if the case be a rheumatic one, and sodium salicylate being taken, it is well to combine with it 5 to 10 grains of iron ammonio-citrate. Strychnine is of great value, and iron perchloride with solution of strychnine, given in full doses well diluted with aerated water, is recommended. Eustace Smith (Practitioner; Amer. Jour. Med. Sci., June, 1902).

The pulse is of great importance both in regard to diagnosis and prognosis. It is apt to be frequent, ill-sustained, and irregular in both force and rhythm. The number of radial pulsations may be considerably less than the number of heart-beats as counted with the stethoscope. The pulse-wave is apt to be small, but in cases where previous high tension, as in arteriosclerosis, has dilated the peripheral arteries, the wave may be of considerable volume. Any approach to tension in the arteries is of favorable import.

The phenomenon known as bigeminal pulse is quite frequent in cases of dilatation. Often the second and weaker of these twin cardiac impulses fails to reach the radius in perceptible strength. Inspection of the cardiac region shows no such bulging as may be present in cases of hypertrophy, except when the precedent hypertrophy has left its traces behind it. It may be difficult to locate the apex-beat by the eye, or the impulse may seem to be diffuse and not to impinge upon exactly the same point with every beat.

Over other portions of the heart than the apex the intercostal spaces may sometimes be seen to protrude and recede with the action of the heart, and sometimes an extensive wavy motion may be observed over the cardiac area. When the right ventricle is dilated, there is more than a usual amount of impulse in the epigastrium below and to the right of the xiphoid cartilage.

Upon palpation the heart-beat is found not to be of a strong and heaving character, but feeble and resembling a quick tapping or slapping of the chest, sometimes with more or less of a tremulous sensation imparted to the hand. Even when the eye has detected the apex-beat, the hand may not be able to distinguish it. The most satisfactory mode of practicing palpation is by resting the whole hand, as lightly as possible, over the præcordium, and then testing the impressions thus received by firmer pressure and by digital touch.

Percussion shows an increase in the area of cardiac dullness varying somewhat according to the portion or portions of the heart mainly dilated. Increase in the size of the right ventricle makes the heart broader than normal, but not much longer. The right limit of dullness may, in such a case, reach or even extend beyond the right nipple. Enlargement of the right auricle is associated with increase of dullness at the right edge of the sternum, corresponding to the second and third intercostal spaces. The dilated left ventricle presents an area of cardiac dullness not much wider toward the right than normal, but extending downward to the seventh or eighth intercostal space, and perhaps an inch or two to the left of the normal position of the apex.

By means of auscultation we may, in the first place, be able more exactly to locate the position of the apex-beat than by either inspection or palpation, assuming that it corresponds to that point where the first sound of the heart is loudest. The first sound of the heart in cases of dilatation may be louder than normal, but it is devoid of muscular quality, being short and valvular; that is, closely resembling the normal second sound of the heart. It is heard with more distinctness in the aortic area than is the

first sound of the hypertrophied heart. Frequently there is also heard a systolic murmur at the apex, due to regurgitation through the mitral valve or tricuspid, because the auriculo-ventricular opening is dilated as well as the ventricle, and consequently has become too large for the valve, even though normal, to close it efficiently (relative insufficiency). The second sounds at the base of the heart are of variable character in different cases. If they are tolerably sharp and distinct they are somewhat reassuring, as indicating that the ventricles still possess muscular power. Another important point (W. H. and J. F. H. Broadbent) is the length of the pause between the first and second sounds of the heart as compared with the pause separating one cardiac cycle from another. If the first and second sounds are separated by a shorter interval than in health, we must infer that the dilated ventricles are able to make only an ineffective effort at systole, while, if there is a longer pause between the first and second sounds of the heart, it is evident that the cardiac muscle still possesses sufficient vigor to make a prolonged effort to overcome the obstacles which it meets in propelling the blood-current.

When tricuspid regurgitation exists, the veins in the neck are dark and turgid. Their valves show like knots. Often actual pulsation in them may be demonstrated, especially if the patient takes a horizontal position. Pressure upon the congested liver magnifies the engorgement of the jugulars.

Diagnosis. — From pure hypertrophy dilatation can be clearly distinguished by the general aspect of the patient, and the evidences of imperfect and failing circulation already detailed. In both conditions the area of cardiac dullness is increased, but in dilatation we do not ob-

serve the strong heaving impulse of hypertrophy. In general, it may be said that the two are opposites. Hypertrophy is an exaggeration of the normal state, while dilatation is a condition of weakness and failure.

The first sound of the hypertrophied heart at the apex may not be so loud or distinct as in dilatation, being low and muffled, and, as already stated, it may be inaudible at the base; but there is present in it a muscular quality, distinguishable in a less degree over the apex of a normal heart, and not heard in cases of dilatation.

The hypertrophied heart must at last, however, enter into the state of dilatation,—unless its owner is the victim of intercurrent disease,—and the important practical question for diagnosis in most cases is to determine what degree of deterioration has already been reached and how much longer the circulation can be maintained.

Very valuable information in doubtful cases with regard to the integrity or otherwise of an enlarged heart may be obtained by causing the subject under examination to make somewhat brisk muscular exertion, as by ascending and descending a flight of stairs or by hopping six or eight yards upon one foot. The degenerated heart will become unnaturally accelerated and irregular, while a well-nourished heart will act even better than before.

In certain cases retraction of the lung, as in chronic phthisis, leaves a comparatively-normal heart more exposed than in health and might occasion a mistake of the condition for one of dilatation. Factors in this diagnosis would be the history of the case, the signs of pulmonary disease, the absence of venous stasis in other parts of the body, and the fact that the border of the lung near the

heart did not extend inward over the cardiac area on full inspiration, as under normal conditions it should.

Mediastinal tumors may cause dullness in the cardiac region, but they are apt to extend upward and to the right or left side; and the heart-sounds are not audible over them in the same way as over the dilated heart. In thoracic aneurism we should expect to find a heaving impulse in the neighborhood of the base of the heart, with other positive signs of aneurism and without the changes in the cardiac sounds and impulse or in the general circulation seen in dilatation.

A more difficult question is to distinguish pericardial effusion from cardiac dilatation. In certain cases this seems to the writer almost impossible, although in the great majority of instances a definite conclusion can undoubtedly be reached. In pericarditis we are more apt to have a history of an acute onset with fever and pericardial friction-sounds, and perhaps, also, knowledge of a nephritis or tuberculosis or acute pneumonia as etiological factors in the production of pericarditis.

The pericardial effusions give an area of dullness somewhat more pear-shaped than that seen in dilatation of the heart, which is, more or less, quadrilateral. Pericardial effusion also raises the apex-beat upward and outward toward the third or fourth spaces in the neighborhood of the left nipple, and it renders the heart-sounds less distinctly audible than in dilatation. It may also cause a paradoxical pulse. Yet, in case of valvular heart disease with a fresh attack of rheumatism, a recent pericarditic friction-sound, and evident failure of compensation, it may be very difficult to determine whether the increased area of dullness on the right side of the sternum

is referable to pericardial effusion or to dilatation of the right ventricle.

In the cases already spoken of there has been a question of mistaking the enlarged area of dullness in the cardiac region due to other causes for a dilated heart. There is a contrary danger in cases of emphysema that a dilated heart may not be recognized because of unnatural pulmonary resonance encroaching upon the true cardiac area. Here we may be saved from error by the history of chronic bronchitis, and of already-established and slowly-increasing dyspnoea, as well as by the characteristic pulmonary signs.

Etiology.—Increase in the cavities of the heart must be due either to abnormal weakness of their walls or excessive labor in the propulsion of the blood-current. Among obstacles to the circulation should be enumerated valvular disease, arteriosclerosis, chronic interstitial nephritis, atheroma, and congenital narrowness of the aorta. Contrary to what might be presupposed, thoracic aneurism does not cause change in the heart-walls, unless associated with aortic regurgitations. Pericardial adhesions may cause dilatation of the heart, more especially when the outer surface of the pericardium is fastened to the chest-wall or diaphragm.

Exophthalmic goitre and tachycardia cause cardiac dilatation, as may also excesses in tobacco and venery, great anxiety and despondency, leukæmia, and chlorosis.

Causes in 360 cases: Arteriosclerosis in 59 per cent.; chronic nephritis in 13.4 per cent.; valvular lesions in 12.4 per cent.; adhesions in the pericardium in 7.6 per cent.; excessive muscular work in 3.8 per cent.; tumors in 1.9 per cent.; aneurisms in 0.95 per cent. Lafleur (*Montreal Med. Jour.*, May, '95).

Principal causes, other than disease of the valves, myocardium, and pericar-

dium: 1. Organic changes in arterial system. 2. Overfilling of circulation. 3. Foreign substances in the blood. 4. Causes that act on general cardiac nervous system. Arteriosclerosis the most important factor. J. Stewart (*Montreal Med. Jour.*, Apr., '95).

Acute dilatation of the heart can occur in acute rheumatism. Four cases in which no valvular lesion could be found. The lack of resistance of the myocardium doubtless permitted the dilatation to occur. Dilatation is divisible into two classes: one due to primary atony of the myocardium, to be treated by digitalis; the other due to secondary atony of the myocardium, following vasoconstriction and arterial tension. Huchard (*Jour. des Praticiens*, Apr. 27, 1901).

Habitual severe and sustained physical exertion may cause cardiac dilatation, as seen in both athletes and in men following laborious occupations. Sudden dilatation may, indeed, ensue upon a single violent or prolonged muscular effort. In many cases of this sort it is presumable that the myocardium was previously in a vulnerable condition; but yet dilatation may occur in young and apparently healthy men after mountain-climbing, and, after a period of due rest, be completely recovered from. In other cases, however, especially in persons with less elasticity of constitution, the lesion is a permanent one and progresses to a fatal termination.

In ten runners, who had just reached the goal, apex seemed to have deviated to the left from two to three centimetres. In one, affected with aortic insufficiency, apex lowered and notable increase of præcordial dullness, evidently connected with dilatation of right cavities. Among all the men arterial pressure lowered. Mechanism seems to relate to overtaxing, general fatigue, and to secreted toxic products. Teissier (*Le Bull. Méd.*, Dec. 19, '94).

Excessive work thrown upon normal right ventricle presents fairly-distinctive symptom,—namely, pain, localized in the

region of the second and third left costal cartilages; usually dull, but may be acute; sense of tightness in præcordia. In the adolescent type of dilatation increase of size upward and to the left, giving increased area of relative cardiac dullness in third, second, and sometimes first left interspaces. F. Stacey Wilson (Birmingham Med. Rev., Sept., '94).

Cycling tells primarily and distinctly on the heart and circulation. Benjamin Ward Richardson (Asclepiad, Third Quarter, '94-'95).

Several subjects in which death had occurred from heart-strain. Marked dilatation of coronary veins and their subepicardial branches. Microscopically, dilatation seen to extend to capillaries between individual muscle-bundles. Inter-muscular connective tissue granular and cloudy. Muscle-cells showed vacuolar degeneration. Venous congestion and oedema of muscular bundles and connective tissue. Banti (Centralb. f. allg. Path. u. path. Anat., B. 6, Nos. 14, 15, '95).

Segmentary dissociation of the myocardium in a fatal case of strained heart. Fibre seemed to have its continuity broken at the level of the intercellular cement. Félix Ramond (Le Bull. Méd., Dec. 8, '95).

Pulse after violent use of bicycle in some cases reached 250; after ten hours' rest, heart still accelerated: a sign of beginning insufficiency. Mendelssohn (Med. Press and Circular, Jan. 15, '96).

Study of the lesser degrees of cardiac weakness and dilatation. After fatigue the heart is in a temporarily-relaxed condition, similar to that of the skeletal muscles after severe exertion. After wrestling the heart may be temporarily dilated, and, as the pulse indicates, may contract with much diminished force. The temporary and physiological relaxed condition of the organ merges by intermediate degrees into one of actual dilatation. Clinical observations indicating three phases of pathological relaxation of the heart:—

1. A premonitory stage characterized by palpitation, excitability of the heart's action, feeling of fatigue, and slight anxiety. Cases of this kind should not

be regarded as merely nervous. As etiological factors the following are mentioned: Rapid growth at puberty, sexual excesses and masturbation, physical and mental overwork, mental troubles, anæmia, alcohol and nicotine, fatty infiltration, previous illnesses, and premature old age.

2. The first stage of actual relaxation. This is divided into an acute, a subacute, and an intermittent form; such cases are often labeled as cardiac neurasthenia.

3. This class embraces the ordinary cases of actual dilatation, on which so much has been written.

The early stages should be especially sought for. The early stages of cardiac dilatation should be recognized, just as much as the early stages of pulmonary tuberculosis, so that the condition may be opposed in time. Concordance with Gerhardt and Fräntzel that palpation is more important than percussion for estimating the size of a relaxed heart. One must feel in the intercostal spaces for the left ventricle several times and with the patient in different positions, but especially in the leaning-forward position made use of by Gumprecht. Whitwicki and Seeligmüller have observed a marked difference in respiration accordingly as the patient lies on his left or his right side. This may be an important symptom of dilatation of the left ventricle. In one case was noted on repeated occasions an increase of twelve to twenty inspirations in the minute when the patient turned from his right on to his left side. L. Feilchenfeld (Brit. Med. Jour., from Berl. klin. Woch., Feb. 28, '98).

Case in a bicyclist who had been in the habit of taking prolonged rides and who had accomplished several century-runs. Marked hypertrophy and dilatation of the heart, the latter being predominant. In addition a systolic murmur was audible over the cardiac area, with its greatest intensity at the apex. The patient readily becomes dyspnoic; the heart-beat is ordinarily 38 to 40, but under the influence of the slightest excitement or exertion it increases to 80 or 90. J. M. Taylor (Phila. Med. Jour., Apr. 16, '98).

Several cases of acute dilatation of the

heart from bicycling witnessed. Explanation referred to the lack of the aspiratory action of the heart during the ride, and the excessive pumping action of the muscles of the extremities exerted on the veins and lymphatics,—both of which lead to a distension of the right heart. F. A. Packard (*Phila. Med. Jour.*, Apr. 16, '98).

In the etiology of cardiac dilatation the two essential factors are: (1) the element of increased mechanical strain and (2) myocardial weakness, primary or secondary. H. A. Caley (*Lancet*, June 3, '99).

Active dilatation of the heart, or hyperdiastole, is frequently met with. Normally the heart-muscle dilates actively within certain limits in order to receive the incoming blood-stream. Under some circumstances this hyperdiastole is increased beyond the normal. It then amounts to an active dilatation of the heart. The conditions that cause this may be nervous, or alteration in the blood, but particularly those conditions in which, as in anæmia, there is a demand by the tissues for a larger quantity of blood. This demand cannot be met by merely increasing the number of pulsations, as the blood would not remain sufficiently long in contact with the tissues. It can be met only by increasing the amount of blood driven out at each stroke. Hyperdiastole may be seen under physiological circumstances at times, as in normal persons, after climbing mountains. It is often seen after hot baths, during digestion, and, at times, during pregnancy. H. Herz (*Deutsche med. Woch.*, Feb. 22, 1900).

Other causes are acute nephritis, as after scarlet fever, rheumatic pericarditis and myocarditis, pneumonia, and typhoid fever. Influenza certainly may precipitate dilatation, if it does not actually cause it.

Defective development of thorax important in the etiology of pseudohypertrophies of adolescence. Thorax elongated and constricted; heart forced downward, apex sometimes as low as

fifth intercostal space. Huchard (*La Semaine Méd.*, Nov. 3, '94).

Connection between kidney disease and cardiac hypertrophy attributed to primary toxicity of the blood. De Dominici (*Wiener med. Woch.*, Nov. 17 to Dec. 1, '94).

Ingestion of a pint of water causes blood-pressure to return to normal in one hour; after ingestion of pint of wine or beer blood-pressure becomes normal only after two hours. Great beer-drinkers nearly all suffer in a few years from dilatation of the heart. Bollinger (*Med. Press and Circular*, Aug. 28, '95).

Rôle ascribed by some authorities to ordinary growth in production of organic cardiac conditions, notably hypertrophy, cannot be demonstrated. Potain and Vaques (*La Semaine Méd.*, Sept. 25, '95).

High tension in the systemic arteries, aortic stenosis, and aortic regurgitation cause a predominant change in the left ventricle as compared with the other cavities.

Results of examinations of 139 vessels of all sizes. In smaller arteries thickening affecting both muscular and fibrous coats. Thickening greater in small vessels than in larger. With chronic granular kidney hypertrophy of the muscle and of the fibrous tissue of whole arterial system connected with left side of the heart and of muscles of the heart. W. Howship Dickinson (*Lancet*, July 20, Aug. 3, '95).

In certain grave states of cardiac dilatation, and in advanced valvular disease, the blood-pressure as tested by Hill's instrument may be enormously high: a fact accounted for by admitting that the ventricle is called upon to work at its highest pressure. Nicholson (*Brit. Med. Jour.*, Apr. 13, 1901).

In aortic regurgitation the dilatation is beneficial with certain limits. Inasmuch as a certain portion of the blood pressed into the aorta with each systole is at once allowed to return to the ventricle, the total amount of blood pressed out with the systole must be greater than in health, or there will inevitably be a

diminution in the normal amount in the arterial system. In its final development aortic insufficiency presents dilatation of all the cavities of the heart. In case of mitral regurgitation there is also dilatation of the left ventricle, because a leak in the mitral valve during systole over-distends the left auricle, and during diastole the blood rushes into the left ventricle under more than normal tension, enlarging its cavity. The usual and chief effect of mitral lesions, however, is enlargement of the right side of the heart: at first of the right ventricle, and, when it begins to fail, also of the right auricle. The right auricle seldom undergoes much hypertrophy; any increase in its size is apt to be a pure dilatation.

Hypertrophy is never primary in a hard-working heart, whether increased labor be due to resistance from within, from without, or to nervous stimulation and augmented action. Primary dilatation is a compensatory element. Residual blood dilates the cavities, and diminishes the extent to which each fibre is called upon to contract. J. G. Adami (*Montreal Med. Jour.*, May, '95).

The stress of initial stenosis, pulmonary stenosis, and chronic pulmonary disease falls upon the right side of the heart. Predominant dilatation of the right ventricle makes the heart globular in shape.

Temporary dilatation of the heart may occur under both physiological and pathological conditions. It cannot be explained as only apparent and ascribed to the action of respiration, for ordinary respiration does not sensibly modify the area of the cardiac dullness, and may occur four or five times in a minute. The phenomenon may be explained by suddenly increased intracardiac pressure or by diminished tonicity of the ventricular wall. G. Sée (*La Méd. Mod.*, June 4, '91).

Reticulated condition of the myocardium observed in the case of a woman afflicted with mitral obstruction and re-

gurgitation, who died, at the age of 40, after eighteen months of chronic asystole. The interstitial spaces of the myocardium were found to be dilated without signs of an inflammatory process. The author's explanation is that a chronic interstitial oedema had stretched apart the muscular fibres, and that the condition was a result of venous and lymphatic stasis. Maurice Letulle (*Bull. de la Soc. Anat.*, No. 25, '93).

Acute dilatation of the heart occurring in the course of cancerum oris. The area of cardiac dullness had rapidly extended, the apex was beating an inch and a half external to the nipple, and over area there was heard for the first time a loud, blowing, systolic murmur. The principal point of interest in the case is the rapidity with which the heart dilated. When the patient came under observation it was noted that her heart was healthy and its area of percussion normal. In the course of the illness the apex of the heart could be seen getting carried farther and farther daily, and all at once a mitral systolic murmur developed, and the pulse became rapid and irregular. The heart dilated owing to malnutrition of the myocardium, either from fever or from the poisoned blood, and the mitral systolic murmur that developed was adynamic rather than endocarditic. Thomas Oliver (*Edinburgh Med. Jour.*, Mar., '98).

An examination of the minute structure of the myocardium in dilatation may show either interstitial myocarditis or fatty degeneration, or there may be no change in the heart-fibres appreciable even with the microscope. In certain of these cases it would seem probable that the nervous ganglia connected with the heart may be at fault. In marked dilatation the pectinate muscles themselves are flattened into mere tendinous cords.

[The accompanying illustrations are from photographs of specimens in the Warren Museum in the Harvard Medical School, for advice and assistance in obtaining which I am indebted to the courtesy of Dr. William F. Whitney, Curator. HERMAN VICKERY.]



Fig. 1.—Dilated left ventricle with a cardiac aneurism at apex. Case of chronic interstitial myocarditis in a man aged 84.

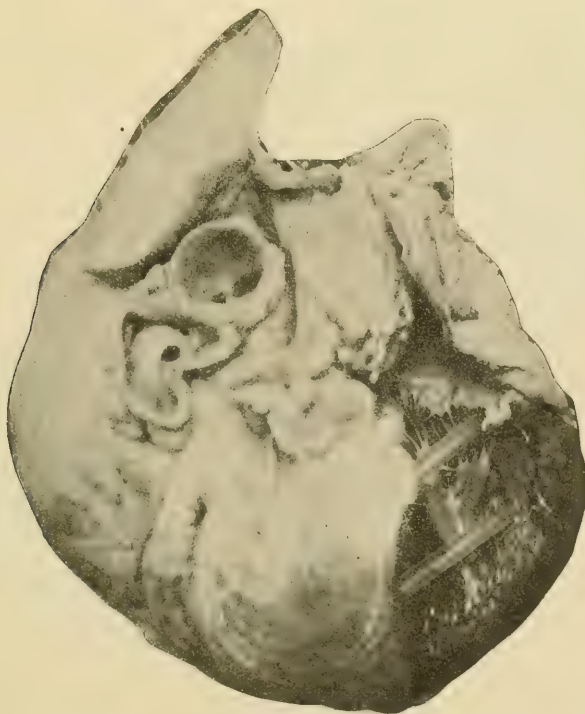


Fig. 2.—Excessive dilatation, with hypertrophy, of the right ventricle. Valves of pulmonary artery united to form a smooth fibrous diaphragm with a small opening in the centre. Left ventricle laid open, not enlarged. Case of a boy aged 14. Cyanosis, dyspnoea, sudden death.



Fig. 3.—View of right ventricle of same heart.



Fig. 4.—Left ventricle greatly dilated, but its walls of normal thickness. Aorta extremely atheromatous and enlarged. Man aged 44. Cardiac symptoms of pain, dyspnoea and palpitation for ten years. Death in a seizure.

Prognosis.—It will be seen from what has gone before that dilatation of the heart is a condition which it is not proper to generalize when considering any individual case. The state might be said to bear the same relation to heart conditions that jaundice holds to the liver and digestive tract. Each case should, therefore, be carefully considered on its own merits or demerits.

The most acute transitory form of dilatation is probably that which occurs in athletes and others under great or long-continued effort. The majority of these persons, if in good health and well trained, seem to escape permanent injury. It will be found, however, that a certain important proportion of those who engage in violent and desperate competitive physical exertions, as for instance, a long boat-race, suffer for years thereafter from discomfort in the cardiac region, with some tendency to irregularity of the pulse.

Those who train athletes should appreciate this possibility. The first degree of dilatation and consequent venous stasis is shown by pallor, for this reason: as the left ventricle becomes tired, blood accumulates in the right side of the heart and the systemic veins in more than normal amount, yet not exceeding the capacity of the venous system. As a consequence of this increase of blood in the venous channels, there is less blood than normal in the arteries, causing a pallor which does not advance to cyanosis until a much greater amount of blood is present in the veins. If, then, a person engaged in vigorous exercise changes from the ordinary pink flush of countenance to a decided pallor, the limit of safe exertion has been reached. Cyanosis conveys a still more imperative warning.

With regard to the more common and

usually slowly-developing forms of dilatation, it should be said that there may be many degrees of the disease in different persons. Here, too, sudden progress in the wrong direction may occur, as the result of overstrain,—changing a moderate into a severe case. In general, it may be said that the patient does not often survive a well-marked condition of cardiac dilatation for more than twelve or eighteen months.

The factors upon which we should lay weight in determining the reserve power



Fig. 5.—Dilated left ventricle showing trabeculae flattened and indistinct. Mitral valves extensively destroyed and covered with large vegetations.

of a dilated heart are of two kinds: rational and physical. If the disease has come on in one whose habits can be greatly changed for the better, with regard either to overindulgence in alcohol, tobacco, the pleasures of the table, and such like, or sorrow, anxiety, overwork, and long hours of sustained effort, then the chances are somewhat more favorable than if the subject has led a physiologically blameless life. The judiciousness or unsuitableness of the treatment heretofore adopted should also

be considered. And those who have previously undergone one or two attacks of cardiac failure are to be regarded in a more dangerous condition than during their previous illnesses.

Irregularity in the pulse is not necessarily of evil import, but a great frequency of the pulse-rate is discouraging. Of course, any degree of vigor in the cardiac impulse is a welcome discovery, as is also a sharp and decided quality in the second sounds at the base of the heart. The case may be considerably affected in its course by our ability to obtain for the patient a fair degree of sleep and maintain a sufficient nutrition of the body.

It is oftener possible to produce a certain degree of improvement than to maintain it, to say nothing of completing the recovery.

A fatal termination may be preceded by attacks of syncope, often most alarming; but death is more apt to come at the end of a comatose condition than with extreme suddenness. Embolism and thrombosis may also prove terminal factors.

Prognosis in acute cardiac inflammation of a severe type is much worse in childhood than in later life. There are three reasons for this: (1) the frequency with which both the endocardium and pericardium are involved, (2) the great tendency to acute dilatation, and (3) the liability of these attacks to be complicated with pneumonia. Holt (*Archives of Pediatrics*, Dec., '99).

Treatment.—Absolute rest in bed is very desirable if the patient is able to enjoy it. In many cases, however, the sufferer cannot assume the horizontal position, but is obliged to sit either propped up in bed or in a chair where he may bend his knees. For such unfortunates, sleep is often best obtained by providing them with a shelf or rest

in front of them at about the level of the elbows, on which they may lean, bending forward. There are special tables made with a leaf reaching over the bed.

In primary weakness and dilatation of the heart which develop chiefly in anæmic and scrofulous children, they should be taken away from school at once, kept absolutely quiet in fresh air (preferably at the sea-side), and given the best possible diet suitable for their age and digestive power. Martins (*Congress of Inter. Med.*, Carlsbad, Apr. 11 to 14, '99).

The diet is of nearly equal importance with bodily rest. It should be bland, easily digested, and given in small amounts at intervals of two or three hours. Some cases have seemed to do well on a purely-milk diet, particularly such as have suffered from high arterial tension. In most, however, a variety of rather concentrated, but simple, viands is preferable. Thus we may allow eggs, fowl, underdone beef or mutton, beef-juice, and gruels made with one-half milk and one-half water. Alcohol as a beverage or long-continued tonic is useless and harmful. It should be reserved for emergencies, unless, indeed, the patient has become so accustomed to it that a small amount of whisky or dry wine is almost necessary to stimulate the appetite and digestion. It is the view of some that habitual alcoholic stimulation is more desirable in old age than in earlier life; but the writer's experience has satisfied him that, in the condition under consideration, great caution should always be used in regulating the administration of alcohol.

Constipation and flatulence interfere with abdominal respiration and impede the venous circulation. Laxatives are consequently of great value, and more especially hydragogic cathartics. En-

largement of the liver increases the advisability of their employment. In suitable cases the relief from a purge is almost magical. It seems to produce the same mechanical effect that venesection would without the loss of strength which the latter measure involves. The favorite drug is mercury, either in the form of blue mass or the mild chloride. This may be followed the next morning by a dose of sulphate of magnesium or sodium in concentrated solution. It is said that the advantage of mercury over other cathartics is that it not only depletes the veins, but dilates the capillaries, and thus lessens the obstruction which the weakened heart has to overcome. Another efficient and not very unpleasant remedy for the same purpose is composed of equal parts of bitartrate of potassium and compound jalap powder, of which the dose is 1 or 2 teaspoonfuls. By far the best cardiac stimulant in this condition is digitalis. It should be given in efficient doses. If the desired effect is not obtained with ordinary amounts, the remedy should be gradually pressed until either there is improvement or nausea interferes with its further administration. In some cases it may be given by means of an enema when the stomach altogether rejects it. Its well-known cumulative action should be remembered, and it should not be longer continued if nausea begins or the amount of urine diminishes. In fact, practically, one must be ready to suspend it about as soon as it produces a marked satisfactory effect (see DIGITALIS). As substitutes for digitalis, tincture of strophanthus, caffeine, and sulphate of sparteine may be employed, their probable efficacy being in the order named.

Pellets of cactina, $\frac{1}{100}$ grain each, one being given every two hours during the

day; especially effective in weak and dilated heart. Kola cordial as a cardiac tonic. Campbell (Montreal Med. Jour., June, '95).

Sparteine sulphate successfully used in cases of passive dilatation of the heart, especially without marked valvular lesion. It is often necessary to permanently continue the drug, but no increase of dose is necessary. The dose is $\frac{1}{2}$ to 1 grain every four hours. P. M. Chapman (Birmingham Med. Rev., May, '99).

In subacute dilatation of neurotic or anæmic young people, where baths and exercises are not available, nutrients like malt, iron, quinine, and the alkaloids of nux vomica may check the dilatation and restore the heart's tone. In general, strychnine or brucine, in $\frac{1}{60}$ - to $\frac{1}{30}$ -grain doses are good nerve-tonics, but, as they contract both heart and arterioles, are undesirable for continuous use. T. E. Satterthwaite (Medical News, Dec. 28, 1901).

Strychnine is often of great value and may be combined with any of these or given independently. Iron is useful for its beneficial effect upon the nutrition of the heart-wall. Quinine and arsenic are advised in certain cases. It is hardly safe to give the latter to subjects in whom fatty degeneration is suspected. On the other hand, arsenic sometimes appears particularly efficient in cases where there is cardiac pain.

Minor forms of cardiac dilatation found in anæmic girls just past the age of puberty. They suffer from menorrhagia, constipation, and flatulence. In these cases the action is, as a rule, rapid, and the first sound is exaggerated and seemingly irritable. Best results come from strychnine and digitalis in moderate doses for a week or two, to be followed by a prolonged course of iron. Beverly Robinson (Amer. Jour. Med. Sci., Aug., 1900).

Massage may do good in two ways, both by promoting general nutrition and by assisting in the propulsion of the blood. The Schott method of treat-

ment may be of advantage in less-alarming cases where there yet remains some muscular integrity in the heart. Oertel's method of treatment is suitable in so far as the amount of liquid ingested may often be limited to advantage, but unsuitable with regard to the forced muscular effort he advised. Climbing is more useful for obesity with fatty overgrowth of the heart than for conditions of cardiac dilatation. Accumulations of fluid in the abdominal or thoracic cavities should be withdrawn. It is sometimes surprising how much benefit will follow the removal of twelve or sixteen ounces of water from the chest or a few quarts from the abdomen.

In well-marked cyanosis with considerable enlargement of the liver half a dozen leeches may give relief. They may be applied directly over the liver and the subsequent bleeding should be encouraged by warm, wet compresses.

Blood-letting is a very important remedy when the heart is dilated and there are passive congestions and dropsy. It is especially valuable in dilatation of the right heart when there is still considerable tension. Venesection is not to be performed in the very young or old. Leeches to the epigastrium may be employed when venesection would be too great a shock. The amount of blood to be withdrawn depends upon the plethora of the patient and the effect noticed. Allyn (*University Medical Magazine*, Dec., '99).

In many bad cases of dilatation of the right heart, with cyanosis and orthopnea, when nothing but a large venesection appears to hold out a promise, one, two, or three doses each of 10 or 12 grains of digitalis, given at intervals of three or five hours, will contract the heart and restore pulmonary and general circulation; on the other hand, in chronic conditions of weak heart, of either muscular or nervous origin, or of insufficient action caused by pulmonary obstruction,—as in chronic broncho-

pneumonia or in tuberculous infiltration,—small doses of digitalis, that is, from 4 to 6 grains daily, or its equivalent, may be given for weeks and months and even years without any hesitation. Such doses may be ordered while the patient is not expected to be seen for weeks or months. In most personal cases prescribed either from four to six doses daily of Squibb's or any other good fluid extract or the solid extract of the "*Pharmacopœia*" in the shape of pills, $1\frac{1}{2}$ grains (0.1 gramme) daily, usually $\frac{1}{2}$ grain (0.03 gramme) three times a day, almost always in pills, rarely by itself, often in combination with sparteine, or strychnine, or arsenic or other drugs, as the case may require. Patients who take digitalis in this way do not show a cumulative effect, nor are they getting accustomed to it to such an extent as to lose the benefit of its action.

The indications for the use of digitalis are the insufficiency of the heart-muscle and the incompetency of the mitral valve. Chronic myocarditis is no contra-indication. Large doses may over-exert the inflamed muscle; that is why digitalis in large doses is very badly borne in acute myocarditis; small doses are often serviceable when the first onset is passed. Aortic insufficiency has been declared a contra-indication to digitalis by some, an indication by others. It is certain that these observers had different cases to deal with. Aortic insufficiency, when incipient or moderate, is easily compensated, gives no uneasiness to the patient, is not complained of, and is seldom observed when recent. This is the time when such doses of digitalis continued a long time prove of permanent service. Only those, however, can be thus benefited whose cases are recognized early, either accidentally or through careful self-observation by the patient. When, however, the case is old and compensation greatly disturbed, with considerable peripheral venous obstruction, even digitalis will not suffice to restore the equilibrium between the action of the heart and the capillary circulation of distant organs. A. Jacobi (*Medical News*, Jan. 11, 1902).

The legs in some instances are immensely distended with fluid. Bullæ are apt to form, which burst spontaneously and exude dropsical fluid. Large amounts of water may sometimes be drawn from the lower extremities through Southey's capillary trocars or by means of longitudinal scarifications. A practical objection to the latter method is the great danger of erysipelas attacking the scarified tissues. Apart from that, the constant dripping day and night torments the patient and soon causes more or less eczema of the skin. But the relief to the circulation is, in some instances, worth even the immense amount of trouble and the considerable risk thus entailed.

For the attacks of syncope to which these patients are liable, the subcutaneous injection of digitalis, nitroglycerin, ether, alcohol, or strychnine is necessary. Marked relief and apparently valuable stimulation are sometimes obtained by the inhalation of oxygen-gas, which has once or twice seemed to the writer actually life-saving in its efficacy. In such cases, however, a fatal termination is merely delayed, not absolutely prevented.

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DILATATION OF THE STOMACH.

See STOMACH, DISORDERS OF.

DIPHTHERIA.—From the Greek: *διφθέρα*, a skin or membrane.

Definition.—Diphtheria is an acute infectious and contagious disease produced by the presence and development of the Klebs-Loeffler bacillus. As it occurs in man, it is usually characterized by the presence of false membranes upon the surfaces primarily attacked, especially the mucous membranes of the nose, pharynx, larynx, or trachea. There

can no longer be any question of the specific relation between the great majority of cases of the disease known since the time of Bretonneau as diphtheria and the bacillus with which Klebs and Loeffler have identified their names. The bacillus is regularly obtained in cultures from affected throats; it can readily be isolated; and when pure cultures are injected in animals they reproduce the essential features of the disease met with in man. Welch and others, by inoculating the mucous membranes of guinea-pigs, have even succeeded in producing the false membranes so closely associated with the disease in man. All the constitutional effects and characteristic lesions, except the formation of membrane of diphtheria, have likewise been produced by the injection in animals of the toxins produced by the specific bacillus. In experimental diphtheria, induced either by the injection of cultures of the Klebs-Loeffler bacillus or of its toxins, the most striking feature is the production in animals of the paralyses due to nerve and muscular degenerations, such paralyses reproducing most exactly the phenomena so often observed in clinical diphtheria. This feature of the experimental process has so impressed itself upon those most interested in laboratory researches that some propose to define diphtheria as an acute infectious disease, produced by the action of the Klebs-Loeffler bacillus, and characterized by the development of nerve-degenerations.

While this teaching may be most in harmony with the combined evidence of clinical observation and laboratory research, it does not yet seem advisable to so far depart from the conceptions of diphtheria which have heretofore obtained. The appearance of false membrane has long been regarded as almost

diagnostic; it still belongs to the great majority of cases, and can readily be appreciated, while the nerve-degenerations, if they appear at all in clinical diphtheria, are met with only in the later stages of the disease, long after the question of diagnosis will have been determined.

Varieties.—The classification of the acute inflammations affecting nose, throat, etc., has not yet reached a satisfactory stage. The distinctions based upon the presence or absence of pseudomembranes have lost their significance.

While the great majority of pseudomembranous inflammations of these parts are due to the action of the diphtheria bacillus, a considerable number of such inflammations are produced by the action of other bacteria, especially the streptococci and staphylococci. On the other hand, the action of the diphtheria bacillus is not always attended by the production of pseudomembranes. The intensity of the local action of the bacilli varies greatly, and it has been found that this diphtheria bacillus may be the cause of simple inflammatory processes, formerly designated as catarrhal, which present no appearance of false membranes. Moreover we find that the all-important question in any case, both with reference to prognosis and treatment, is the presence or absence of the diphtheria bacillus. We, therefore, abandon the former classification into catarrhal and pseudomembranous processes and speak of:—

1. *Diphtheria*, or *true diphtheria*, in which we include all cases of acute inflammations affecting mucous membranes associated with the presence of the diphtheria bacillus in sufficient number to constitute a probable causative agent. Thus, if a culture from a sore throat show the presence of the

diphtheria bacillus, that case is at the present time accepted as diphtheria, whether there be or not pseudomembrane present, and no matter what other bacteria be associated in the culture with the diphtheria bacillus. It must, however, be noted that the presence of the diphtheria bacillus without further clinical evidence does not constitute diphtheria any more than the presence of pneumococci in the mouths of healthy persons constitutes pneumonia.

Following conclusions are based upon a study of 1075 cases, comprising children of all ages from one to eighteen years, among whom were encountered 134 cases of clinical diphtheria and from whom were obtained 8000 cultures. Of these children, 275 were kept in absolute individual isolation, and under conditions admitting of the most careful oversight, in which the chances of reinfection were reduced to the minimum. While the Klebs-Loeffler bacillus is undoubtedly present along with staphylococci and several other varieties of bacilli in every case of diphtheria, its mere presence is no guide as to its virulence or non-virulence. This bacillus, or one morphologically identical with it, is present in the throats in nearly one-third of all the children and possibly adults. It is found as frequently in the throats and noses of those who have never had clinical diphtheria as in those who have sustained acute attacks of the disease, but in the former is often of variant type. J. H. Adair (Northwestern Lancet, Sept. 1, '99).

From a study of the throat cultures of 285 healthy individuals, 7 of which showed the presence of diphtheria bacilli, and of 190 healthy boys whose throat cultures showed the presence of the Klebs-Loeffler bacilli in only 16, the following conclusions have been drawn: 1. Diphtheria bacilli are seldom found in the throats of those who have not been exposed to diphtheria. 2. The bacilli are more frequently found in those who have been exposed, especially in persons living under poor hygienic conditions or

in institutions. 3. The conditions of institution life which favor the growth of the bacilli in healthy throats are the living together of a large number of persons in a limited air-space. 4. Healthy individuals with virulent bacilli in their throats can spread the disease. They are just as dangerous as mild or convalescent cases of diphtheria, and ought, therefore, to be detected and isolated. 5. Cultures ought to be made among those who have been exposed to diphtheria; (a) by physicians among the members of a family who have been exposed; (b) by inspectors in the schools; (c) by the health officers under any circumstances when they think the disease is being or may be spread by such individuals. F. P. Denny (Boston Med. and Surg. Jour., Nov. 22, 1900).

Not only are there definite and distinct species of diphtheria bacillus, but each species has distinct subspecies and varieties with characteristics which continue to persist under different conditions. Thus, varieties as well as species remain separate, and when grown under similar conditions the species show no tendency to become converted the one into the other, while the varieties gradually change, approaching a common norm. Since in a series of ten cases of clinically typical diphtheria only one variety of the specifically virulent diphtheria bacillus was obtained from the throat of each case throughout the course of the disease, since from different parts of the same patient only one variety was isolated, and since pseudovarieties were found no more frequently at the end than at the beginning of the disease, it is safe to infer that specifically virulent bacilli do not readily, if ever, change into any form of non-virulent diphtheria bacilli in throats or noses of people during an attack of diphtheria. In a second group a number of healthy throats were examined and many distinct varieties of diphtheria-like bacilli were found, all of which, however, in serial pure culture, retained their characteristics. From a third group the inference was drawn that not only does a variety of the bacillus retain its characteristics for some

time in the same throat, but that it may be transferred to other throats without losing its individuality. Finally a number of cultures were examined which had been kept in the laboratory for years. These were freshly inoculated every few days, and but few changes were found in the general shape and properties of the bacilli, as compared with the original observation. A. W. Williams (Jour. of Med. Research, June, 1902).

2. *Pseudodiphtheria*, in which we include all cases resembling diphtheria but not showing the presence of the diphtheria bacillus in cultures from the affected parts. Such pseudomembranous inflammations are commonly seen as complications of the acute infectious diseases, especially scarlet fever and measles. Cultures from such cases regularly show the presence of streptococci or staphylococci or both. The streptococci are especially frequent. Pneumococci and other bacteria have been found.

The site of the diphtheritic process, whether nose, tonsils or pharynx, or larynx, materially affects the symptoms and course of the disease; we therefore, in our description, speak of *nasal*; *pharyngeal*, or *tonsillar*; and *laryngeal diphtheria*. In the effort to further classify their cases some divide them upon the basis of the bacteriological findings in cultures from the throat. Thus, when the culture shows diphtheria bacilli practically alone, they designate the case as bacillary diphtheria; when cocci are present in considerable numbers with the diphtheria bacilli, as coccobacillary diphtheria, etc. This method would be highly satisfactory did the clinical course and outcome of the disease correspond to the bacteriological findings, but they do not. The presence of cocci in the cultures does not show that they will

play any important part in the disease, and the complications produced by their action—such as pneumonia and nephritis—seem to be as frequent in cases that give apparently pure cultures of the diphtheria bacillus from the throat as in those that show many cocci as well. When we have to do with a systemic infection with streptococci as well as the diphtheria bacilli, we speak of the cases as “mixed infections”; but the distinction is based upon the clinical symptoms of the disease and not upon the results of the bacteriological examination. We find it most advantageous to divide the cases into mild, severe, or septic, according to the character of the symptoms presented.

Corresponding to these three forms of diphtheria, Monti presents a classification based upon the character of the exudate in the throat:—

1. A fibrinous form in which the diphtheritic products are only placed upon the mucous membrane, not incorporated with it. Virchow, Weigert, and Cohnheim call this the croupous form.

2. A mixed form, called also the phlegmonous form, in which the fibrinous exudate lies deep in the tissues as well as upon the mucous membrane.

A septic, or gangrenous, form, in which a fibrinous pseudomembrane is formed in the deep tissues of the mucous membrane, the process really consisting of a necrosis of the tissues and a mingling of the dead particles with the diphtheritic products.

Similar classifications are presented by other Continental writers; but we have not yet found it of advantage to attempt to classify our cases by the local appearances of the throat. Certainly the distinctions that Monti makes call for very nice and rather difficult discriminations.

Symptoms.—These vary sufficiently

with the site of the lesions to make it of advantage to consider the local forms separately.

1. **NASAL DIPHTHERIA.**—Diphtheria of the nasal cavities is, in most cases, simple extension from the fauces, or larynx. It may, however, occur as a primary affection. It is characterized by more or less complete obstruction of the nares; a thin, muco-purulent, and often bloody discharge from the nostrils; and a more or less marked toxæmia. Pseudomembrane may be developed and may be visible through the anterior nares, but, as a rule, we see no membrane. The nasal discharge is usually very irritating and the nares become excoriated.

The degree of the toxæmia varies markedly. Usually it is very moderate, the temperature is not high (100° or 101°), the prostration is not marked, and the chief danger of the cases seems to lie in an extension of the process by continuity of tissue, to the pharynx or larynx, or the development of pneumonia.

The affection is often protracted, the discharge from the nose and the obstruction persisting for weeks, despite careful treatment.

Lennox Browne reports a total mortality of 63.4 per cent. in a series of cases of diphtheria involving the nose, and attributes to the nasal affection more importance than to the laryngeal. Few writers or clinicians can agree with this opinion. In practically all the cases of the series reported other parts were involved besides the nares, and the mortality-record is a tribute to the gravity of extensive diphtheria rather than to the danger of the nasal affection alone. In infants, however, nasal diphtheria frequently proves fatal. It may readily be the origin of a pharyngeal or laryngeal process. It may, furthermore, be the

means of communicating the disease to others.

2. PHARYNGEAL, OR TONSILLAR, DIPHTHERIA.—(A) *Mild Cases Without Membrane, or Catarrhal Diphtheria.*—

During the prevalence of an epidemic of diphtheria, especially in institutions, a certain number of cases may be observed in which, without the appearance of pseudomembrane, the pharynx and tonsils become reddened and somewhat swelled, the children complain of slight soreness of the throat and have a rise in temperature, but do not appear or feel very ill; yet cultures made from such throats show the presence of the diphtheria bacillus. Such cases we have learned to class as true diphtheria. The mildness of the affection is attributed either to the small number of bacilli present, to a diminution in the virulence of the bacilli, or to an increased resistance on the part of the patient. In many of these cases the nose is involved as well as the pharynx and tonsils, and there is consequently a thin, watery, irritating discharge from the nostrils. In the course of a few days all symptoms subside, and the bacilli disappear, or they may persist for weeks without further symptoms.

Series of 20 children in which the bacillus was found in 6 on admission, while in the other 14 cases it was discovered at times varying from a few days to several weeks after admission. The infants in whom the bacilli were present in the mouth presented no symptoms, either general or local. These bacilli often remained for several weeks, and even months (in one case two and a half months), in an indolent condition, although in several cases they declared themselves in a virulent manner. Of the 6 children who arrived at the hospital with diphtheria bacilli already in the mouth, only 1 came from a family in which there had been a case of diphtheria five weeks previously; 2 came

from a house infected by measles, and the remaining 3 had not been in contact with any cases of infectious disease. In 12 cases the bacteriological examination was supplemented by inoculation of animals. The bacilli found in 6 cases were so virulent as to cause the death of the animals in from twenty-four to forty-eight hours, while in the other 6 cases the virulence was only of medium intensity. Heubner (*Jahrb. f. Kinderh.*, B. 43, S. 54).

Diphtheria bacilli may exist in the throat for months after an attack, and they may occur in the healthy pharynx. Cases of chronic exudate are, however, much less common. The following illustrates the latter: A 19-year-old servant-girl became ill with general symptoms and an ulcer on the right half of the soft palate, in the secretion of which virulent Loeffler bacilli were found. During the next five months there continued to be an exudate in the pharynx in which virulent diphtheria bacilli could always be demonstrated. The bacilli were characteristically influenced by the Behring serum, while it had no effect on the exudate. The blood-serum of the patient protected twenty times more than normal serum against injections of Loeffler's bacilli. F. Jensen (*Centralb. f. innere Medicin*, No. 19, '97).

The bacilli derived from cultures from such cases may prove to be fully virulent, and any such case may readily be the means of communicating a severe or virulent type of the disease to others.

The patients themselves may show albuminuria during the course of their mild attack, or they may later develop the paralyses belonging to the severer types of diphtheria. The latter outcome is, fortunately, rare.

From the catarrhal process in the throat and nose there may arise by extension a diphtheritic laryngitis either catarrhal or pseudomembranous in character, which may be followed by stenosis or other grave symptoms.

(B) *Mild Cases, with Membrane, of Pharyngeal, or Tonsillar, Diphtheria.*—These cases are characterized by the development of more or less pseudomembrane upon the tonsils, fauces, or pharynx, and a moderate toxæmia. The onset of the trouble is marked by sore throat; a moderate fever, 100° or 102° ; and a slight prostration. Upon examining the throat we usually find one or both tonsils reddened, swelled, and presenting upon their surfaces one or more patches of pseudomembrane. These patches may be small and difficult to distinguish from the yellow plugs seen in follicular tonsillitis. The membrane is usually firmly adherent to the underlying tissue, and, if removed, leaves a bleeding surface. The area covered by membrane may sometimes be marked off from the surrounding tissues by a zone of congestion. The membrane is usually white-gray, or grayish-green in color, sometimes yellow, and the patches are of irregular form. It is sometimes thick and heavy, sometimes so thin as to be translucent. Over against this description of diphtheritic membrane we might set the characters of pseudomembrane not diphtheritic, but the more painstaking the description, the more evident would it become that it is perfectly impossible to distinguish one from the other by simple inspection. Nothing short of a bacteriological examination will enable us to make the distinction with certainty.

The presence of the Loeffler bacillus is a sure sign that the accompanying pseudomembranous inflammation is diphtheritic; the bacillus of diphtheria may be present without causing symptoms of the disease; the bacillus may disappear when the symptoms cease, or may continue in a virulent state for months upon the fauces of the infected person. Loeffler (Lancet, Sept. 8, '94).

With such appearances in the throat there is usually a distinct swelling and tenderness of the submaxillary and cervical lymph-nodes.

The extent of membrane in the mild cases is usually limited, and there seems little tendency toward spreading; but, on the other hand, we may see cases in which tonsils, fauces, and pharynx are covered with membrane and yet the constitutional depression is slight.

After the onset in a mild case the membrane may extend somewhat, so as to involve the fauces or pharynx; but may remain limited to the tonsils. The throat continues sore, the temperature shows some elevation, and the children feel moderately sick. In the course of three to five days the membrane begins to separate, either gradually or in masses, the throat clears up, the temperature falls, the glandular swelling subsides, and in a week or so the patient is well again.

A mild diphtheria may be accompanied by albuminuria, and may be followed by nephritis or paralysis, but, as a rule, the cause is benign and the outcome satisfactory. We must, however, be prepared at any time to see an apparently mild case of diphtheria change character and become a virulent infection. From a mild tonsillar, or pharyngeal, diphtheria a severe diphtheritic laryngitis may be developed.

The most troublesome features of these mild cases of diphtheria is the difficulty of maintaining proper quarantine. If adults, the patients do not regard themselves sick after the first day or two, and can hardly be made to understand that even when well they may be the source of grave danger to others.

If the patients are children, the parents find it difficult to take a serious view of an apparently trifling sore throat and are often unwilling to take the necessary

precautions to prevent the spread of the disease. It cannot be too emphatically laid down in such cases that the clinical phenomena are no test of the virulence of the bacteria present. From an apparently mild case Para obtained the most virulent bacillus he has yet met with, and employed its toxins in the production of antitoxin of unusual strength. It has likewise long been well known that an apparently mild case of diphtheria may communicate a malignant infection to others.

The mild cases should be quarantined just as faithfully as the most severe, and should be allowed freedom only when the specific bacteria have disappeared from the throat.

(C) *The Severe Cases.*—In these the manner of onset may be sudden, with chill, vomiting, fever, and severe sore throat, the temperature rising to 103°-104°, and the prostration being marked, or the affection may begin as a mild case and gradually develop the severe symptoms, the invasion being very insidious. If seen at the beginning, there may be little membrane visible in the throat, only a small patch or two upon the tonsils, exactly similar to that described in the mild cases; the throat will, however, be more reddened and the swelling more marked. The submaxillary and cervical lymph-nodes will be swelled and tender. The child looks and acts sick. The elevation of temperature may not be in keeping with the degree of constitutional depression, oftentimes being only 101° to 102°. As the disease develops, the membrane rapidly extends, until the tonsils, pharynx, uvula, and fauces are covered with a thick gray, green, or even black layer of necrotic material. If any effort be made to remove it the underlying tissues bleed freely. The membrane fills the rhino-

pharynx, involves the nasal cavities, and may even appear in the nares. With the involvement of the nose there is seen a thin, acrid, often bloody and foul-smelling discharge from the nostrils. The membrane may also invade the mouth and appear upon the lips. In one case seen at the Foundling Hospital, the extent of gray membrane upon the lips, cheeks, and tongue was so marked as to suggest the possibility that the child had been drinking carbolic acid. Mechanical removal of the membrane in such cases does no good whatever; it seems only to open up a fresh surface to the attack of the virulent bacilli, and the membrane is reproduced with almost marvelous rapidity. At any time the inflammatory process may involve the larynx, giving rise to laryngeal diphtheria, or it may involve the middle ear through the Eustachian tubes; in rare cases by extension through the lacrymal duct or by accidental inoculation the conjunctiva is involved.

With the increase in the local process the lymph-nodes of the neck become more swelled and tender, until it seems that they will surely suppurate, but they rarely do so. The constitutional depression becomes more and more marked. The pulse becomes more rapid and feeble; the strength fails steadily.

Eight hundred consecutive cases of diphtheria observed. Less than half of the cases in which the pulse-rate exceeds 100 recover. The pulse-rate and the mortality appear to be very much in a direct ratio to each other, and recovery is improbable when the pulse gets above 150. Extreme slowness of the pulse is less significant; but in children bradycardia does at times presage evil. Variations of rhythm and volume occur in some 10 per cent. of all cases, and are a useful premonition of cardiac complications. A systolic murmur at the apex of the heart is heard in about one

case in ten; its significance depends entirely upon its cause. This is far more commonly mitral insufficiency, due either to weakness and inadequate contraction of the cardiac muscle, or to dilatation of the left ventricle, but in rare instances to an endocarditis of diphtherial origin. Hibbard (Boston Med. and Surg. Jour., Jan. 27, Feb. 3, '98).

The temperature may not at any time be very high, 101° or 102°, or it may reach 103° or 105°. The swelling and tenderness of the throat render swallowing painful and sometimes almost impossible. The tonsils may almost meet in the median line, the nostrils may be plugged and even respiration seriously interfered with. At times in the early days of the disease we may see fluids regurgitate through the nose, when any attempt to drink is made, and it may be difficult to determine whether the regurgitation is due to the obstruction of the throat by the swelled tonsils or to an early paralysis of the pharyngeal muscles.

As the diphtheria advances, the urine becomes scanty and high colored, and contains albumin in some quantity; at times an acute exudative nephritis is developed, with large quantities of albumin, casts, and even blood. The onset of the complication may bring, in its train, all the symptoms of an acute nephritis.

Examinations made for albuminuria in 279 cases of diphtheria, it being found in 131; rate of mortality, 50.37 per cent. No evidence of albuminuria could be discovered in 148 cases,—the rate of mortality here being 14.2 per cent. Cases free from albuminuria thus afford a more favorable prognosis. Baginsky (Archiv f. Kinderh., B. 16, H. 3-6, '93).

Results of examination of 1000 urines in diphtheria by both Fehling's test and the phenylhydrazin test. In 230 cases examined reaction was noted in 25 per cent. of all cases; in those that recovered it was obtained in 19 per cent.; and in the fatal cases in 77 per cent. In cases

without false membrane no reaction was obtained.

In a second series of 96 cases a positive reaction was obtained in 33 cases by both tests.

The glycosuria was often associated with albuminuria. A certain number of cases were examined before and after the injection of antitoxin, and it was found that for a few days after the injection a slight glycosuria sometimes occurred. Hibbard and Morrissey (Jour. of Exper. Med., Jan., '99).

Diphtheritic albuminuria has no other relation to diphtheritic paralysis than that both complications are more prone to occur when the diphtheritic intoxication is most intense. E. F. Trevelyan (Lancet, Nov. 24, 1900).

The mind may remain clear throughout; but, as a rule, with the deepening of the toxæmia the patients become dull and listless. In the severest cases stupor or delirium may be developed. Coma is rarely seen. Convulsions may occur either early or late in the disease, from the toxæmia of the diphtheria or from uræmia.

In some cases the patients die from the diphtheria toxæmia alone; but in most of the fatal cases one or the other of the complications is the direct cause of death. Most important of these is the pneumonia. Although most often seen in laryngeal cases, pneumonia is a common sequel of diphtheria, either nasal or pharyngeal. The onset of the broncho-pneumonia is usually marked by a decided rise in the temperature, a quickened respiration, and some cough. Not till the pneumonia has advanced to the consolidation of large areas do definite physical signs attest its presence. Usually we hear more or less numerous fine crackling râles over one or both chests posteriorly. Later there may be scattered areas of dullness, with bronchial voice and breathing. For evidence of the onset we must depend upon the

rational rather than the physical signs. The development of pneumonia is always a grave and often a fatal complication. In but few fatal cases do we fail to find a more or less extensive involvement of the lungs, and in the greater number it plays an important part in the unhappy outcome.

If the view at present generally held, that the complicating pneumonia is dependent upon the action of streptococci and not upon that of the diphtheria bacillus itself, and therefore antitoxin can only indirectly affect its onset or its violence, be true, then the problem of further reducing the mortality of diphtheria must depend upon the solution of the prevention and treatment of this complication. At present it is of importance to watch for signs of its onset and to be prepared to take measures to limit its extension and enable the patient to bear the attack. The most malignant cases of diphtheria die within forty-eight hours of the onset of the disease, and even in these we find more or less extensive areas of broncho-pneumonia. Most of the fatal cases terminate after five or ten days, the patients being exhausted by the toxæmia of the disease or the pneumonia.

In the more favorable cases improvement usually begins about the fourth or fifth day. The change is shown in both the blood and the general condition. In the throat the membrane ceases to extend and begins to separate. The separation begins upon the edge of each patch, the separated portions forming loosened tags in the nose or throat, or the membrane may come away *en masse* in the form of casts of the affected parts. The surface beneath the membrane is at first raw and bleeding, but is usually quickly covered by new epithelium. On the tonsils, however, ulcers are

formed, which, healing slowly, leave irregular, depressed areas of cicatricial tissue, giving to the tonsils the excavated appearance so often seen after severe diphtheria. With the separation of the membrane the purulent discharge from nose and mouth gradually ceases, but a catarrhal secretion may continue for weeks afterward, such catarrhal secretion still containing virulent bacilli.

With the change in the local condition the temperature gradually falls, the pulse improves, the glandular swellings subside, the dullness or stupor disappear, and at the end of the second or third week the patient is convalescent. The patients are usually left very anæmic, and the return to health is likely to be slow.

From time to time we see cases in which the formation of membrane continues for two or three weeks, the course of the disease is protracted and recovery correspondingly delayed. In other cases the broncho-pneumonia persists long after the disappearance of all evidences of the diphtheria, and may either cause death from exhaustion or may slowly dissolve.

3. CASES OF MIXED INFECTION, OR SEPTIC DIPHTHERIA.—Under this head are grouped those cases in which bacteriological investigation shows the presence of the diphtheria bacillus, together with other pathogenic bacteria, usually streptococci, in some cases pneumococci, and in which these additional organisms seem to exert a definite influence upon the course of the disease. Most of these cases are fatal and in post-mortem examinations systemic infection with streptococci or pneumococci is said to be found. The appearance of the membrane in these cases does not differ essentially from that seen in the severer

forms of infection with the diphtheria bacillus alone. It may be white, yellow, gray, or olive colored, or, where hæmorrhages accompany the inflammatory process, more or less black. The membrane is usually extensive, covering the tonsils, pharynx, fauces, and uvula. The swelling of the affected parts is usually very marked, the oedema being pronounced, the tonsils often so filling the throat as to preclude examination of the pharynx and giving rise to dysphagia and dyspnoea. There is the same muco-purulent or bloody discharge from the nose and mouth; the nares are obstructed and the patients often breathe only through the mouth. A peculiar sickening, sweetish fœtor is characteristic. The lymphatic nodes and cellular tissues of the neck are most commonly swelled and indurated, the process in many cases leading on to suppuration and occasionally to gangrene. The pressure upon the veins of the neck may produce congestion of the head and swelling of the face. The swelled, dusky features, with the sanious discharge from nose and mouth, is characteristic and impressive.

The constitutional symptoms are those of a profound septicæmia. The temperature often runs as high as 104° or 106°, but may not be remarkable. The pulse is rapid, feeble, and compressible. With the feebleness of the pulse, the extremities may be cold and pale, in marked contrast to the dusky face. Vomiting and diarrhoea are common, and may be persistent. The urine contains considerable albumin and casts, and in some cases blood. The quantity may be diminished; suppression may occur and cause death from uræmia. Oedema of feet or hands may be seen. The liver and spleen may both be enlarged. The cerebral symptoms are

marked. The patients are usually dull and stupid, indifferent to their condition or surroundings, but at times they are delirious and extremely restless, tossing continually from side to side or crying out as though in pain. Broncho-pneumonia is very common and usually hastens death. At any time during the course of the disease the larynx may be involved by extension. The cases, as a rule, terminate fatally within a week, sometimes within forty-eight hours. Rapid failure in the strength of the heart marks the fatal progress of the disease, and the end may be brought about by sudden and unexpected syncope. If they survive the first violence of the infection, these cases are especially liable to complications attributed to the pathogenic action of the streptococci, such as suppuration of the cervical lymph-nodes and cellular tissues, broncho-pneumonia, and nephritis.

Results of the examination of 234 cases of membranous angina bacteriologically:—

1. Loeffler's bacillus was absent in 26 cases, there being present staphylococci, streptococci, pneumococci, and bacillus coli communis. Two died,—1 of meningitis. Excluding this 1, the mortality was 3.84 per cent.

2. Loeffler's bacillus occurred alone in 102 cases; mortality 28,—27.45 per cent.

3. Loeffler's bacillus found in association with the staphylococcus pyogenes in 76 cases; mortality 25,—32.89 per cent.

4. Loeffler's bacillus found with streptococcus pyogenes in 20 cases; mortality 6,—30 per cent.

5. Loeffler's bacillus with streptococcus and pneumococcus (Fränkel's) in 7 cases; mortality 3,—43 per cent.

6. Loeffler's bacillus with bacillus coli communis found in 3 cases, all of which ended fatally. De Blasi and Russo-Travali (Riforma Med., Nos. 179, 180, '96).

4. **LARYNGEAL DIPHTHERIA.** — The clinical picture of laryngeal diphtheria does not present such variety as is seen in diphtheria of the pharynx and tonsils. The local effects, due to the anatomical form and structure of the larynx and its physiological function, predominate over the constitutional symptoms. The mucous membrane of the larynx possesses but little absorptive power; so that as long as the diphtheritic process is limited to the larynx the toxæmia is slight.

From what has been already said it is evident that we may have laryngeal diphtheria:—

1. As a primary affection.

2. As an extension of a process beginning either in the nose or the throat.

It may also occur:—

3. As a complication of other infectious diseases, especially measles or scarlet fever. In the latter relation it is less common than the pseudomembranous laryngitis produced by the action of staphylococci or streptococci (pseudo-diphtheria), and occurring as a complication it presents itself in one of the two preceding ways, either primarily, or secondarily to diphtheria of the nose or throat.

Diphtheria of the larynx begins gradually with a hoarse cough and voice, and perhaps a slight stridor with inspiration. The temperature is usually low,—99° to 101°,—and the child does not appear very sick. The early stages are not to be clinically distinguished from acute catarrhal laryngitis, except that the onset of the latter is usually more abrupt and the temperature higher,—102° to 103°. The course of diphtheritic laryngitis has the following rather characteristic sequence of symptoms: Croupy cough, croupy inspiration, aphonia, stridulous expiration, suprasternal and infrasternal recessions, restlessness and jactitation,

and cyanosis. The cough becomes more and more hoarse, the voice, at first hoarse, fails steadily until the aphonia becomes complete; the stridor, at first only affecting inspiration, shows itself with expiration and becomes louder. With the increase in the local symptoms, the temperature may continue low or may mount step by step to 104° or more. At the end of the first or second day the symptoms of laryngeal stenosis become well developed. The voice is sunk to a whisper or lost altogether, the cough is very hoarse and short (tight), there is loud stridor with both inspiration and expiration, and every effort to fill the chest grows slower and more labored. With each inspiration there is more or less marked depression of the suprasternal, and supraclavicular spaces and the epigastrium. The finger-tips are blue, the lips livid, the face pale, the forehead and perhaps the whole body bathed in perspiration as the child struggles to overcome the increasing obstruction to respiration. The perfect clearness of mind is in marked contrast to the dullness or stupor usually seen in severe types of diphtheria elsewhere. As the agony increases, the child sits up, supporting the shoulders by the arms to give free play to all the accessory muscles of respiration, or, wild with fear, throws himself from side to side or up and down in a vain effort to shake off the tightening grip upon his larynx. It cannot be too strongly laid down that the laryngeal stenosis seen in these cases is largely the result of spasm of the laryngeal muscles excited reflexly by the inflammatory process and in small part the result of mechanical obstruction by membrane or the swelling and œdema that accompany it. Often we see fatal cases of laryngeal diphtheria, in which the stenosis has required operative treatment,

showing only a fine granular membrane, the lumen of the larynx still wide. How much swelling and œdema may disappear at the time of death we cannot say, but certainly membrane alone rarely obstructs the larynx. This view is strengthened by the common experience that any excitement greatly intensifies the severity of the stenosis. A child may sleep quite comfortably though breathing stridulously and with some labor; waken it and with the first frightened cry the larynx closes as though in a vise, and, unless the child be quickly quieted, operative relief will soon be required. This point is dwelt upon at such length for the purpose of enforcing its consideration in treatment. Quiet will do a great deal in controlling advancing stenosis. Vomiting will, for a time, relax the spasm, but in true diphtheria the stenosis rapidly returns. At any time the severity of the stenosis may relax, the symptoms all gradually subside, and the patient go on to make a good recovery, but, unless relieved by treatment, the cases usually end in death by suffocation. In such a case the cyanosis deepens, the respiration becomes more and more labored, the violent struggles for air cease, the patients sink into stupor, convulsions develop, and death soon follows.

Such an outcome is most common in infants, who usually succumb in from twenty-four to forty-eight hours from the onset. In other cases the course is slower; the disease reaches its height in from two to three days and terminates within a week.

Broncho-pneumonia is a common complication of laryngeal diphtheria. It may develop as the result of direct extension of the membrane from the larynx to the trachea and bronchi, or it may result from the inspiration of the

inflammatory exudate containing pathogenic bacteria. The mode of its development cannot be clinically determined. Its presence is indicated by heightened temperature, more rapid respiration, greater cyanosis, usually numerous coarse or subcrepitant râles over both chests posteriorly, and more marked prostration. It makes the prognosis much more grave in any case and frequently causes death when the stenosis has been relieved by operation. It was one of the late Dr. O'Dwyer's observations that, in descending diphtheria, when the membrane passed from the trachea into the median bronchi, this invasion of a new territory was marked by a rapid rise of temperature which, in turn, was soon followed by developing pneumonia.

When laryngeal diphtheria develops secondarily to diphtheria of the nose or throat, or as a complication of the infectious diseases, the symptoms above described are superadded to those of the original affection, and the patient is all the less likely to survive.

Complications and Sequelæ.—Otitis media is an occasional complication of diphtheria. It is developed by direct extension of the inflammatory process through the Eustachian tubes and belongs to cases in which the rhinopharynx is involved in the diphtheritic process.

The middle ear is very commonly affected in diphtheria; but the onset of the invasion is free from pronounced symptoms, and is mild in character throughout; it is not an extension along the Eustachian tube, but is an affection of the mucous cavities of the ear complicating diphtheria: one of the symptoms of a general infection. Lommel (*Archives of Otol.*, Apr., '97).

In some cases the ear affection is of the severest type and there is consider-

able destruction of the drum-membrane. It may even result in gangrene. Pneumonia, as already noted, is the most frequent and dangerous complication. It is most common in laryngeal diphtheria, but may follow any form of the disease. It is attributed to the action of the pyogenic cocci, especially the streptococci, though Stephens and Kanthack, Wright, More, and others have demonstrated the presence of the diphtheria bacillus in the lungs.

During a period of two and one-half years there were treated at the South Department of the Boston City Hospital 157 patients who had measles and diphtheria. Of these, 54, or 34 per cent., died. (The death-rate in the uncomplicated diphtheria patients for practically this same period was less than 13 per cent.)

From these cases one must conclude that the existence of diphtheria or the possibility of its onset should be considered in every case of measles, for the congestion of the mucous membrane of the tonsils and air-passages caused by the measles process renders it especially vulnerable and an unusually good field for the growth of the bacilli of diphtheria. Nasal or laryngeal obstruction arising during an attack of measles almost certainly means diphtheria. If the initial fever of measles disappears, and there is later a sudden rise of temperature, or if the cough of measles becomes "brassy" in quality or paroxysmal in character and is accompanied by an elevated temperature, the possibility of diphtheria must be considered. If the initial fever persists and aphonia develops, diphtheria is probably the cause. Uncomplicated measles in very exceptional cases may produce aphonia, but aphonia with or without a rise of temperature usually means diphtheria, and aphonia with a rise of temperature always means diphtheria. Uncomplicated measles is usually accompanied by a more or less abundant serous nasal discharge; but if this discharge becomes purulent or muco-purulent in character, or if there is partial or complete nasal

obstruction accompanied by a glairy discharge, diphtheria should be suspected and cultures taken. But if the patient's general condition in addition to the above symptoms suggests diphtheria, antitoxin should be given at once without awaiting the results of cultures. In all obscure cases the patient should be given the benefit of the doubt—and antitoxin.

If an epidemic of measles occurs in an institution in which large numbers of children are cared for, each child as it develops measles should be given an immunizing dose of antitoxin, and all inmates of the institution should be carefully watched for the earliest symptoms of either disease. D. N. Blakely and F. G. Burrows (*Boston Med. and Surg. Jour.*, July 25, 1901).

The affection takes the form of broncho-pneumonia and is commonly met with in the lower lobes, but may be seen in any part of the lungs. The areas are scattered and separate or may merge into one another till considerable portions of both lungs are consolidated. This complication usually develops at the height of the disease, but may occur at the very beginning, within the first twenty-four hours, or may arise during convalescence after the throat is clear. Its onset is marked by increased temperature; disturbance of the pulse-respiration ratio, —namely, from a relation of 1 to 4 to 1 to 3; greater prostration and the signs of a diffuse bronchitis; only when considerable areas are involved do we obtain the signs of consolidation.

Pleurisy is rarely met with. Empyema may develop, especially in septic cases. Emphysema is frequently seen in laryngeal cases; it may be interstitial and may extend to the cellular tissues of the neck, but is commonly vesicular. The heart is more seriously affected in diphtheria than in any other of the acute infectious diseases, and many of the fatal cases are due to rapid or sudden heart

failure. It follows tonsillar or pharyngeal diphtheria frequently, and is rare after other forms. Goodall, in a recent study of these cases, gives three types of the affection:—

1. Heart-failure while the exudate is still present in the throat and before other symptoms of paralysis present themselves. It is then due to the direct action of the diphtheria toxins upon the nerve-mechanism of the heart.

2. Heart-failure after the disappearance of membrane, but during the time of other symptoms of paralysis, when it may be due either to disturbed innervation or to fatty changes in the heart-muscle, such as are met with in other fevers.

3. Heart-failure during convalescence, some time after the disappearance of membrane; it is then probably caused by degeneration of the heart-muscle or of the pneumogastric nerve (neuritis).

Careful autopsies made of twenty-two cases in which death was due to some cardiac complication. In eight of these cases the vagus, stained by Marchi's method, showed evidence of degeneration. The cells in the nucleus showed no change, even when there was marked degeneration of the fibres of the nerve. The myocardium in these cases was not systematically examined, but the weight of the heart was found to be almost constantly increased. If four weeks have elapsed without any indication of cardiac trouble, there is little likelihood of its appearance at a subsequent period of convalescence. J. J. Thomas (Boston City Hosp. Med. and Surg. Reports, '98).

Whether occurring early or late in the disease, the symptoms of involvement of the heart are, in general, the same: the pulse becomes either more rapid or more often slower; it may be intermittent or irregular; in any case it is much weaker. The patients are greatly prostrated, may refuse food, and may vomit repeatedly.

The surface of the face and extremities may be pale and cold, or there may be dyspnoea without cyanosis. There may be some præcordial distress. After continuing in this condition for hours or days the patients may rally, the heart gradually resumes its normal action, the symptoms disappear, and recovery ensues. More often the alarming symptoms grow worse and the patients succumb to the cardiac weakness. Death may be caused by sudden syncope induced by slight exertion or excitement. In some of the cases the patients are regarded as thoroughly convalescent and may be up and about, when sudden and unforeseen paralysis of the heart results in instant death. The cardiac affection, while most often seen after severe diphtheria, may be a sequel of the mildest cases. Hæmorrhages into the skin or from mucous membranes may be met with during the height of the disease. They are most frequent from the nose and may be so severe as to require plugging of the posterior nares. They may occur from other mucous membranes: the stomach, intestines, or rarely the bladder. In the skin the hæmorrhage may give rise to petechiæ or may infiltrate considerable areas.

The petechiæ are most often seen upon the abdomen and lower extremities, but may occur upon any part of the body. They are caused by changes in either the blood or the vessels or both, and are usually seen in the severer types of toxæmia. The hæmorrhages are in some cases sufficient to seriously exhaust the patient and may even cause death.

The complications following the use of antitoxin, while at times painful and inconvenient, are quite harmless. In a study of one hundred cases it was found that all rashes have their beginning, apparently, in the vicinity of the injection, and are more marked in this region. When joints and adjacent tissues

are painful there may be slight swelling, but it is exceptional to find fluid, and the overlying skin is usually normal. Hips, knees, wrists, and hands are most commonly affected. The rash usually appears first, and the pain subsequently. The temperature-curve is irregular, varying from 100° to 105° F.; it is especially high when pain is present and with the morbilliform rash. Albuminuria was found in about 50 per cent. of the cases. The amount was small, and it was present a short time only. Abscess at the seat of injection is due to infection through the needle; it is more frequent in septic cases and where scarlet fever is present. Healing quickly follows incision. Bruising of the tissue is present in 8 per cent. of the cases; it lasts from four to seven days. Bolton (*Lancet*, Apr. 1, '99).

Thrombosis and embolism are among the rarer complications of diphtheria. They may affect the extremities, giving rise to the usual symptoms: sudden pain, numbness, and coldness of the limbs, followed by paralysis, œdema, and even gangrene. Some of the cases of cardiac paralysis may be caused by thrombosis or embolism of the vessels of the heart. Affecting the cerebral arteries, thrombosis, embolism, or hæmorrhage may give rise to hemiplegia.

In very rare cases the stomach may be involved in the diphtheritic process; but, apart from such involvement, gastric symptoms are common. Persistent vomiting is a frequent and grave occurrence in severe cases. It may be due to the fever and toxæmia, or to nephritis or to heart-failure.

Case of stricture of œsophagus following diphtheria in child 5 years old. The absolute impermeability of the œsophagus necessitated the performing of a gastrotomy, and the child was fed through the fistula. An œsophagoscopic examination showed no cicatricial tissue, no projection, only an infundibuliform contraction at the point of the second dorsal vertebra. After progressively di-

lating with laminaria pencils, Schreiber's method was employed and the child is now perfectly well. Rosenheim (*Méd. Mod.*, July 2, '98).

Diarrhœa is often met with during the height of the disease, and may persist for some time after the diphtheria itself is improved. It may be due to enterocolitis or may be dependent upon the constitutional condition, especially in the septic cases. The local lesions are not severe and have no direct relation to the diphtheritic process. As already noted, hæmorrhages may occur from either stomach or intestine in rare cases.

The kidneys are more or less affected in all severe cases of diphtheria. The lesion may be an acute degeneration, marked by more or less albumin in the urine, or acute exudative nephritis with albumin and casts, but without dropsy or uræmic symptoms. Very rarely an acute diffuse nephritis with diminished urine containing albumin and casts, or suppression of the urine, dropsy, and uræmia may be seen.

The albuminuria usually comes on during the height of the disease, continues for a time, and disappears rapidly with improvement in the local symptoms. Only in the rare cases in which acute diffuse nephritis develops are the renal complications likely to persist. Marked albuminuria is always an evidence of a grave infection, while not of itself a serious complication. It is most common in the septic cases, and belongs distinctly to pharyngeal, or tonsillar, diphtheria. In very rare cases there may be hæmorrhages from the kidneys.

Mention has already been made of the fact that, pathologically and experimentally, the most characteristic lesion of diphtheria is that affecting the nervous system and giving rise to paralysis of various groups of muscles. Clinically, paralysis is infrequent, but in its distri-

bution, type, and course, none the less characteristic. In 2448 cases collected by Sanné paralysis was noted in 11 per cent.; in a series of 1000 cases reported by Lennox Browne in 14 per cent.; in 1071 cases belonging to preantitoxin days studied by Goodall, after deducting a mortality of 33.8 per cent., he says he observed paralysis in 125 of the 709 survivors,—17.6 per cent. of the latter number, or 11.7 per cent. of the whole number; in 3384 cases, treated by antitoxin, comprised in the Report of American Pediatric Society, paralysis was met with in 328 cases,—9.7 per cent. of the whole number. Of the 2934 cases that recovered, 276—or 9.4 per cent.—showed paralysis, while, of the 450 fatal cases, paralysis was observed in 52, or 11.4 per cent. Simply taking the totals of these figures without relation to the question of treatment, we have 852 cases of paralysis occurring among 7903 cases, or in 10.7 per cent.

Secondary paralysis occurs very frequently. Out of 1316 cases admitted into Park Hospital, 275 showed distinct diphtheritic paralyses and pareses. One case of diphtheria out of every five patients thus suffered from some paralytic trouble, which was most frequent in cases between three and eight years. There were 80 deaths among the cases that suffered from paralysis, and 64 of these had cardiac paralysis. The average day upon which the cardiac paralysis appeared was the seventh. Average duration of life after cardiac paralysis in cases which died was four days. There were 21 cases of diaphragmatic paresis and paralysis, of which 11 terminated fatally and 10 recovered. There were 110 cases where the palate alone was affected, and 56 cases in which the palate was paralyzed in connection with other muscles, the largest number being associated with the external rectus, and next to that the diaphragm. Meyers (*Lancet*, Sept. 22, 1900).

Paralysis usually complicates the severer cases of pharyngeal diphtheria, but may be seen after milder forms, and it has even been reported as following affections of the throat so mild as to have attracted little or no attention.

The time of the onset of paralytic symptoms varies greatly in different cases. It may occur at the height of the disease in the latter days of the first week or the beginning of the second, but is usually seen some time after the throat is altogether clear during the third or fourth week of the disease, and may occur as late as the tenth week after the onset. In the cases reported by Goodall the paralysis was observed from the seventh to the forty-ninth day.

In 171 cases of diphtheritic paralysis collected by Ross the following distribution was observed: Palate affected in 128; eyes in 77, in 54 of which the muscles of accommodation suffered; lower extremities in 113; upper extremities in 60; trunk or neck in 58; muscles of respiration, 33. Of the 328 cases reported to the American Pediatric Society the distribution was specified in 187.

Of this number in 120 involved the throat (palate, pharynx, and larynx); in 14 the extremities; in 11 the eyes; in 32 the heart; in 1 the muscles of respiration; in 1 the sterno-mostoid; and in 8 the paralysis was general.

Paralysis caused by multiple neuritis, in the majority of cases, must be attributed to the toxic effects of the products of the Klebs-Loeffler bacilli. It occurs in from 10 to 25 per cent. of cases. The treatment of the original disease, by antitoxin, or otherwise, does not appear to have any influence upon the subsequent development, nor does the type, mild or severe, determine its occurrence in any way. The paralysis is the result of a toxic peripheral neuritis, a parenchymatous degeneration of the

nerves, and not of central origin. Francis Huber (*Pediatrics*, June 1, '99).

The dominant lesion in diphtherial paralysis is a parenchymatous degeneration of the myelin sheath of the nerves, and this degeneration affects both motor and sensory fibres alike. F. E. Batten (*Pediatrics*, Feb. 1, '99).

The nervous system studied in nine guinea-pigs which had been injected with filtered diphtheria broth in varying quantities, and also in a number of children who died of the disease. Personal conclusion reached that the paralyses may be either central or peripheral in origin. In the former case, the anterior horn cell first becomes the seat of degenerative changes, as evidenced by abnormal staining reactions, while the nerve-fibre is still normal in appearance. A secondary descending atrophy of the nerve, however, follows upon the disease of the central cell. In the latter, or peripheral type, of which the common palate paralysis is an example, the muscles paralyzed are those in connection with peripheral nerve-fibres which come into close relation with the seat of toxin-formation in the throat and nasopharynx. The central paralyses are toxæmic in origin; the peripheral are due to local and direct irritation. Foulerton and Thomson (*Edinburgh Med. Jour.*, Jan., 1902).

In the series published by Goodall, the palate alone was first affected in 66 per cent. of the 125 cases, and in combination with other muscles it was involved in 12 per cent. more. In a little over one-half of the cases the paralysis was limited, and in 12 per cent. it was generalized. The affection of the throat is therefore much the most common. It may occur alone or be followed by paralysis of other parts: the eye, the extremities, the trunk, or neck. In some cases it precedes the cardiac paralysis, but, as a rule, this most grave form of diphtheritic paralysis appears unannounced. Absence of the patellar reflexes is observed in most cases of diph-

theritic paralysis, even when there is no loss of power or sensation in the lower extremities, and is regarded as a sign of the probable appearance of paralysis elsewhere.

In most of the throat cases the uvula and soft palate alone are involved. Nasal voice and regurgitation of fluid through the nose evidence the loss of power in these parts, and upon inspection we see the uvula hanging straight downward, relaxed, and motionless upon the back of the tongue. Sensation as well as motion is gone, and there will be no response to irritation. If the pharyngeal muscles are involved, there is difficulty in swallowing, and, if the larynx suffers, there will be aphonia and severe coughing upon attempt at swallowing anything by reason of the entrance of food or drink into the imperfectly closed organ. The latter class of cases is very likely to prove fatal through the development of pneumonia from the inspiration of foreign material. In the extremities—arms, legs, or neck—we see more or less complete loss of power and sensation. The paralysis may not, however, be generalized in these parts, but appears at times to attack only the muscles supplied by a particular nerve-trunk, or even a branch of a main nerve. The paralysis may be so extensive as to render the patient perfectly helpless. When the trunk is involved, the gravest danger arises from implication of the muscles of respiration. Usually the diaphragm is first involved, but the intercostals may suffer. If the diaphragm is paralyzed, the respiration is entirely thoracic; if the intercostals, then the diaphragm alone must do the work. Either affection is characterized by attacks of urgent dyspnœa, with cyanosis. The wind being perfectly clear and respiration maintained only by the greatest effort on the

part of the victim, the distress is often terrible. The danger of suffocation is imminent. Such an attack may pass off and there be no return; but more often they recur in a short time. The patient may remain in this condition for several days, before death finally ends the struggle.

Few of these cases recover: only eight in thirty-three of Ross's series. At any time there may be involvement of the pneumogastric nerves as well as the phrenic, the new invasion declaring itself by attacks of abdominal pain, vomiting, and feeble and slow or irregular pulse. At other times the heart may continue to act quite normally despite the respiratory distress.

We have already spoken of the purely cardiac type of this affection, for it is impossible on clinical grounds to separate from one another the cardiac failure due to changes in the myocardium from that produced by involvement of the pneumogastric or other cardiac nerves by the neuritis. Furthermore, the two conditions are often associated. It may be well again to point out the suddenness with which cardiac paralysis may occur by quoting from the Report of the American Pediatric Society the following paragraph: "Observations of some of the individual cases are interesting, particularly those of cardiac paralysis. It is twice stated that the child had gotten up and walked out of the house, where it was found dead.

"Twice death occurred after sitting up suddenly; once, on jumping from one bed to another. One patient of twenty years got up contrary to orders and died soon afterward. Another patient was apparently well, until he indulged in a large quantity of cake and candy, soon after which cardiac symptoms developed and he died shortly."

When the eyes are affected there is indistinctness of vision usually resulting in inability to read, caused by paralysis of the muscles of accommodation. The pupils may be dilated or sluggish in action from involvement of the sphincter iridis. Strabismus or ptosis from paralysis of the extrinsic muscles of the eyes are rarely seen.

One hundred and fifty cases of post-diphtheritic paralysis of accommodation observed. Paralysis set in two to three weeks after the beginning of the diphtheria in the throat, lasted about four weeks, and always disappeared spontaneously. The degree of paralysis was not always proportionate to the intensity of the disease, and ranged from +1 D. to +6 D. for five letters at 9 inches. All the cases except six presented an hypermetropia of 1 to 3 D. This was explained on the ground of childhood hypermetropia.

The onset is sudden, the recovery gradual. Rarely is there paralysis of the sphincter of the pupil. Moll has observed it only four times.

Accompanying paralyses were as follow: Sixteen times paralysis was double and three times unilateral of the sixth pair. Diplopia must be tested for with colored glass. Once a unilateral ptosis. Once insufficiency of the right internal rectus with asthenopia in a chlorotic subject. In the majority of the cases paralysis of the velum palati and the pharynx. The fundus was always normal. H. Coppey (*Arch. d'Ophtal.*, No. 2, p. 117, '97).

Diphtheria is rare in nursing infants, especially soon after birth; should there be distinct contagion, the infant will contract diphtheria easily; the mortality is much higher among nursing infants, because of their decreased resistance and the difficulty in forming the diagnosis; the bacilli enter by the mouth; nasal diphtheria is secondary from the pharynx, while laryngeal and pulmonary complications are very rare. The treatment consists of prophylactic injections of antitoxin in times of epidemic, and larger injections later, re-

peated when necessary, with some local treatment; and, finally, in spite of the antitoxin treatment, the mortality reached 60 per cent. Cristeanu and Bruckner (*Archives de Méd. des Enfants*, Nov., 1901).

The frequency of paralysis is in direct proportion to the severity of the general infection, although a severe palsy may follow a mild type of diphtheritic intoxication. The location of the membrane is of considerable importance as an etiological factor, diphtheria of the posterior nares especially predisposing to both local and wide-spread palsy. The proportion of cases followed by paralysis is variously estimated at from 10 to 30 per cent. Peter (*Medical News*, Feb. 14, 1903).

Facial and glossal paralyses have both been reported, and in some of the severest types of general paralysis the sphincters of the bladder and rectum are said to have been involved.

If the case does not result fatally either directly from the paralysis or from the diphtheria itself or other complications, the paralysis will surely recover. In none of the cases observed by Goodall was the paralysis permanent. The time required depends upon the degree and extent of the paralysis. Those in which the throat alone is affected usually recover completely within a week or two. Cases of multiple or generalized paralysis may require three or four months to regain normal power.

Differential Diagnosis.—The bacteriological investigations inspired by the identification of the Klebs-Loeffler bacillus have greatly simplified the question of the relationship of the various pseudomembranous inflammations.

The fact of not finding diphtheria bacillus in cases of clinical diphtheria always due to some error in technique. Important practical point: On the surface of membrane bacilli frequently die; therefore, if the culture be taken directly from the surface, in majority of cases a

negative result will be obtained. If the wire be passed through the membrane or along its edges a positive result is almost invariably reached. McCollom (*Boston Med. and Surg. Jour.*, May 9, '95).

Loeffler bacillus present in much more than 73 per cent. of real clinical diphtherias. F. G. Novy (*Med. News*, July 13, '95).

We now know definitely that there are but two great types: the one termed pseudodiphtheria, produced by streptococci or staphylococci and belonging to the acute infectious diseases,—measles or scarlet fever,—and true diphtheria, produced by the specific bacillus, and usually a primary and independent affection.

On the other hand, these investigations have added complexity to the problem of diagnosis of throat affections by showing the presence of the specific bacilli of diphtheria in many cases of sore throat free from membrane and previously passed over as simply "catarrhal" sore throat, and also in many of the cases of a fairly definite clinical type, formerly classified as follicular tonsillitis.

There are some anginae which, although resembling diphtheria, are not caused by Loeffler's bacillus. A typical lacunar tonsillitis may appear absolutely indistinguishable from ordinary follicular tonsillitis, and sometimes the diphtheritic process may start in the lowest parts of the tonsils and so escape detection. It is well to isolate cases of lacunar angina, and during an epidemic of diphtheria they should be looked upon with much suspicion. It is better that diphtheria should be diagnosed too often than that cases of true diphtheria should be overlooked. Vierordt (*Berliner klin. Woch.*, Feb. 22, '97).

In the shifting of the lines that has followed these revelations a considerable degree of mental confusion has been engendered and an uncertainty fostered that has led many to lose all faith in the results of clinical observations. If it is necessary to rearrange the lines of classi-

fication somewhat, it is not required that we abandon all our former conceptions or no longer trust to careful observation. In the great majority of cases thorough examination and careful consideration of all the factors concerned will enable one to reach a positive diagnosis without awaiting the results of a bacteriological examination, although the latter should always be employed if possible. For the sake of clearness we shall follow the order adopted in the description of clinical symptoms.

NASAL CASES.—The only cases that are difficult of diagnosis are those of primary nasal diphtheria. The thin, irritating, muco-purulent discharge, often brownish from the presence of blood, is quite different from the abundant, ropy mucus seen in simple catarrhal inflammation. Excoriation of the nares and eczema of the upper lip produced by the discharge are suggestive of diphtheria. Careful inspection may show the presence of more or less white or grayish-white exudate on the mucous membrane, in which case the diagnosis of diphtheria may be safely advanced. Furthermore, the diphtheritic cases are accompanied by some slight rise of temperature, anorexia, and a distinct degree of constitutional depression not seen in cases of simple inflammation. Finally, these cases are much more often seen in institutions where the children are more or less constantly exposed to diphtheritic infection than in private or dispensary practice.

PHARYNGEAL, OR TONSILLAR, CASES.—These often present difficulties in diagnosis, but a full consideration of all the factors in any case will usually lead to a correct judgment. The most difficult cases are the milder ones, where there is little or no membrane and the constitutional symptoms are slight. The

question of exposure should be considered in every case. Children gathered in hospitals or asylums or attending schools are especially exposed to diphtheritic infection, and in them any form of sore throat may justly be looked upon with suspicion. So far as the catarrhal form of diphtheria is concerned, even with a history of exposure, there is no way of making a diagnosis of diphtheria in the early stages except by bacteriological cultures. The after-course of some of these cases—in which we may see invasion of the larynx, broncho-pneumonia, nephritis, or paralysis—may show them to have been diphtheria, when no suspicion has previously been entertained.

When diphtheritic membrane is present in the throat, it usually presents certain definite characters. It begins as a thin, translucent deposit upon one or both tonsils. Gradually or rapidly it becomes thicker, and assumes a white, gray, or grayish-green, brown, or—in malignant cases—black color, and extends peripherally to cover a larger and larger area. It is firmly attached to the mucous membrane or underlying tissues and cannot be easily rubbed off. If removed by force, a raw, bleeding surface is left, and in a very short time the membrane is reproduced in its original or even a greater extent. Beginning upon the tonsils, the membrane rapidly extends to other parts: the lateral walls of the pharynx, the fauces, or uvula. Upon any of these parts the membrane presents the same characters as at the original site. This extension of the membrane is most characteristic of diphtheria. The only cases in which we are likely to see such extension of a pseudo-diphtheritic membrane are the throat inflammations accompanying other infectious diseases, measles, small-pox, and—

most of all—scarlet fever. The great majority of the membranous throat affections seen in the early stages of these diseases are produced by the action of streptococci or staphylococci. When a similar process is seen as a late complication of infectious diseases, it is more probably true diphtheria.

The early temperature in diphtheria is not usually high; it is, in fact, generally lower than in pseudodiphtheria, with an equal amount of membrane. A high temperature in the beginning is, therefore, an indication that the case is not diphtheria. On the other hand, the prostration is greater in diphtheria than in pseudodiphtheria. The pulse is feebler; the patients look and feel sicker than they do when suffering from pseudodiphtheria. The presence of a nasal discharge of the character described as belonging to nasal diphtheria and marked swelling and tenderness of the cervical lymph-nodes help to distinguish some cases in the early stages. Later we look for the development of the typical complications or sequelæ of diphtheria: invasion of the larynx, broncho-pneumonia, albuminuria, or some of the manifold forms of paralysis. The occurrence of any of these processes is usually sufficient to make the diagnosis certain, although it is not impossible that any of them except the paralysis may be seen in cases of pseudodiphtheria. Paralysis subsequent to throat inflammation is seen only in diphtheria. Pseudodiphtheria is, in the great majority of cases, a milder disease and of shorter course than diphtheria. As already remarked, the primary throat inflammation of scarlet fever most closely resembles true diphtheria. In fact, in every case where diphtheria is suspected, the possibility of scarlet fever must be borne in mind and examination made

for the eruption. Oftentimes it will be found at the very first examination; at any rate, a brief delay will suffice to determine the question, as the eruption of scarlet fever so quickly follows the initial symptoms. It may even happen that the throat symptoms of measles may simulate diphtheria, and especially if the eruption be delayed for a number of days. Here, however, there is rarely any membrane at all, and the presence of conjunctivitis, with the simple mucous discharges from nose and throat, should be sufficient to prevent mistake. Furthermore, if Koplik's observation of the occurrence of an eruption of peculiar bluish-white specks upon a reddish background on the mucous membrane of the mouth previous to the appearance of the regular skin exanthem of measles be proved correct, it should furnish another basis for differential diagnosis.

LARYNGEAL CASES.—When the laryngitis appears as the extension of a previous process in nose or throat, except in the case of measles or scarlet fever, we can safely put it down as diphtheritic. The pseudomembranous throat inflammations of measles and scarlet fever often involve the larynx, trachea, and bronchi, although the processes are not diphtheritic. In any other case such extension is almost conclusive evidence that we have to do with diphtheria. The greater difficulty is prevented by the primary cases of laryngitis in children. The characteristic feature of diphtheria of the larynx is its progressive, unremitting dyspnoea with aphonia. The disease steadily advances to laryngeal stenosis and death from strangulation, unless relieved by treatment. Simple catarrhal, or non-diphtheritic, pseudomembranous laryngitis, on the other hand, usually shows frequent and decided remissions—its crises belonging

to the night, the day showing decided remission of all the symptoms. As in the pharyngeal cases, early high temperature belongs rather to the pseudodiphtheria. If laryngeal examination be possible and we can see and determine the character and extent of the membrane in the larynx, we ought to be able to reach a positive diagnosis; but, unfortunately, such examination is not practicable among young children, who furnish the great majority of the cases of acute laryngitis. Of 283 cases of acute laryngitis subjected to bacteriological examination by the New York Board of Health, 229—or 80 per cent.—proved to be true diphtheria; so that in the city, at least, the diagnosis in any such case would incline to diphtheria.

DIFFERENTIAL DIAGNOSIS.

Diphtheria.	Pseudodiphtheria.
1. Exposure to infection from previous case of diphtheria.	1. No such exposure: arises independently.
2. Greatest liability in early years: first to fifth year.	2. Occurs at any age.
3. Membrane either seen from first upon pharynx, fauces, or uvula, as well as tonsils, or rapidly extends to these parts.	3. Membrane limited to tonsils.
4. Membrane firmly attached to underlying tissues, and not easily rubbed off.	4. Membrane loosely attached and easily removed.
5. If membrane be removed, leaves bleeding surface.	5. Membrane may be removed without such bleeding.
6. If removed, membrane is very rapidly reproduced in an even greater amount.	6. Reproduction of membrane not so rapid or extensive.
	7. Discharge from nose, thin, irritating, often bloody, and produces eczema of upper lip.
	7. Nasal discharge not so common, and is simple, muco-purulent.
	8. Submaxillary and cervical lymph-nodes swelled and tender.
	8. Swelling of lymph-nodes not so marked in primary cases; is regularly met with, however, in throat inflammations of scarlet fever, etc.
	9. Membrane may be seen upon buccal mucous membrane, tongue, angles of the mouth, or lips.
	9. Not seen upon these parts.
	10. Onset gradual; temperature low at beginning.
	10. Onset more sudden; temperature higher.
	11. Constitutional depression is more marked, the pulse weaker, and children more prostrated.
	11. Constitutional symptoms usually in proportion to temperature; more moderate. Pulse rapid, but not weak, and depression not so marked.
	12. Course longer: usually five days to a week before marked improvement is seen.
	12. Course shorter, except in cases complicating infectious diseases; is usually three or four days.
	13. Albuminuria common and severe nephritis frequent.
	13. Much rarer.
	14. Larynx often involved by extension.
	14. Larynx rarely attacked secondarily, except in measles or scarlet fever.
	15. Paralysis of more or less extensive groups of muscles may occur, as a complication or sequel.
	15. No such paralysis seen.

While it is true that, as many authorities maintain, in 95 per cent. of the cases which an expert after careful consideration would pronounce diphtheria, cultures will show the presence of the specific bacillus, it must be frankly ad-

mitted that there are many cases in which the most careful observation cannot determine positively the question whether a given case is true diphtheria or pseudodiphtheria. Thus, in Scientific Bulletin No. 1, of the New York Board of Health, we find it stated that "Baginsky, in Berlin, found the diphtheria bacillus in 120 out of 154 suspected cases; Martin, in Paris, in 126 out of 200; Park, in New York, in 127 out of 244; Janson, in Switzerland, 63 out of 100; and Morse, of Boston, in 239 out of 400. Thus, from 20 to 50 per cent. of the cases sent to diphtheria hospitals did not have diphtheria." If these figures approximate the truth, it is evident that we cannot trust with safety to clinical observations to determine the specific relation of cases of throat inflammation. On the other hand, the routine use of cultures from all cases of sore throat regularly shows the presence of the diphtheria bacillus in a considerable number of cases in which there were few or none of the features regarded as characteristic of diphtheria, and in which there was, therefore, little or no suspicions of the presence of the specific bacillus.

While so far as the individual case is concerned, it may be remarked that the cases in which the diagnosis is most difficult are the mild cases, those least likely to be attended with grave consequences to the patient himself, the fact should also be recognized that these mild cases are quite as dangerous to others as severe ones, and should, for the sake of the community, be subjected to strict quarantine. It is, therefore, essential to accurate work and proper care, as well as proper prophylaxis, that cultures should be made from all cases of sore throat. In no other way can we stand upon solid ground with relation to

treatment, or hope to eventually gain control of the wide-spread and dangerous infection.

[Scientific Bulletin, No. 1, Health Department of the City of New York, is the source from which the great part of the material of this section is drawn. W. P. NORTHRUP and DAVID BOVAIRD.]

METHODS OF MAKING BACTERIOLOGICAL EXAMINATIONS.—An immediate microscopical examination of the exudate in cases of suspected diphtheria will often justify a positive diagnosis. A bit of membrane removed from the throat by a swab is smeared upon a cover-glass or slide, dried, fixed by heat, and then stained with Loeffler's methylene-blue solution.

With an oil immersion lens we may then be able to determine the presence of bacilli sufficiently characteristic to warrant a positive diagnosis. The bacilli under such conditions do not have the characteristic features which are presented by cultures upon suitable media. They are much more irregular in size, shape, and staining properties. Positive judgment is, therefore, much more difficult and uncertain. Failure to find the bacilli by this method would in no way prove that the case was not diphtheria. The uncertainties of the method are so pronounced that it is rarely employed.

Method adopted by Chicago Health Department for making early diagnosis of diphtheria consists in spreading a little mucus from the throat on a slide, allowing it to dry, then staining and examining microscopically immediately. In about 50 per cent. of cases a sufficient number of bacilli is found to warrant a diagnosis. In case the Klebs-Loeffler bacilli cannot be found in this way, patients lose little by waiting for incubation of cultures. During four years the mortality of 38 per cent. from diphtheria, not including laryngeal cases, has fallen in Chicago to 6.7 per cent., in-

cluding all forms of the disease. This is thought to be due to the improved methods by which early diagnosis is made possible, and the early use of antitoxin. W. K. Jaques (*Jour. Amer. Med. Assoc.*, Oct. 29, '98).

Diphtheria bacilli and other bacilli sometimes identical in appearance with the diphtheria bacilli, and sometimes so short and round as to be indistinguishable from cocci, found in tuberculous lungs. A diagnosis of throat affection, therefore, should not be made wholly from results of a simple smear-preparation, without proper cultures. In number of cases none of the patients had had diphtheria, but inoculating lower animals with the bacilli produced effects similar to those of the Klebs-Loeffler bacillus, and diphtheria antitoxin protected against them. Schuetz (*Berliner klin. Woch.*, Apr. 4, 11, and 18, '98).

With modification of Neisser's stain by Concetti it is possible to arrive at a very early bacteriological diagnosis. The method is as follows: A sterilized glass or iron rod has twisted upon its end a small piece of absorbent cotton, impregnated with glucose glycerinated agar-agar. The rods are kept in sterilized test-tubes. When a culture is to be made, it is removed, the affected part swabbed with the end containing the culture-medium, and the rod at once replaced in the tube. It is then placed in a thermostat and kept at a temperature of 36° to 37° C. In four or five hours' time there will have been sufficient growth to make a smear. The latter is stained with a methylene-blue solution consisting of methylene-blue, 1 gramme; alcohol, 20 cubic centimetres; distilled water, 450 grammes; acetic acid, 5 grammes. This solution should remain on the slide not more than two or three seconds. The spread is then washed with water, after which it has an intense-blue color. A counterstain is employed consisting of 2 grammes of vesuvin in 1000 grammes of water. This solution is heated, and filtered while still warm. The specimen should be exposed to the action of the vesuvin from 15 to 20 seconds and then washed in water. It displaces the methylene-blue. If no

Loeffler bacilli are present, the gross appearance of the smear is brown. The presence of the true or pseudobacilli gives a mixed blue and brown color. Under the microscope the pseudobacilli are stained brown in their entirety. The true bacilli have a brown stain, but the ends of the bacilli present the characteristic blue points, which is the chief differential test. A. L. Goodman (*Med. Record*, Feb. 16, 1901).

The best culture-medium for routine work is the Loeffler blood-serum, coagulated by heat in test-tubes in such a way as to give an extensive slanting surface for inoculation. The swabs used in obtaining the infected material from the throat are made by wrapping a small quantity of absorbent cotton about the end of a small steel rod six inches in length. The swabs so made are inserted into test-tubes, which are then plugged with cotton and the whole sterilized by exposure to dry heat at 150° C. for one hour. To make a satisfactory culture a good view of the throat must be obtained and the swab rubbed upon the surface covered by membrane, or—in the absence of membrane—upon the inflamed parts. In laryngeal cases where no membrane is visible it usually suffices to make the application of the swab either to the tonsils or as low in the pharynx as possible. In such cases if the first culture fail to show the presence of diphtheria bacilli, it is always well to repeat the process, as a second or third culture may show the bacilli previously absent from the accessible parts of the throat. Care must be taken in inoculating the swab not to allow it to touch the tongue or any other part or surface than the one upon which the presence of the bacilli is suspected. Otherwise contaminating bacteria are inoculated upon the culture-media and the value of the culture for diagnostic purposes destroyed.

To carry out these directions in young children it is necessary that they be carefully held. The best method is to have the mother or nurse hold the child upon her right side, the child's face turned toward the light and the head resting upon her right shoulder, one of the holder's arms about the patient's legs, the other controlling the arms. The physician can then usually insert a tongue depressor and control the head with one hand, while with the other the swab can be properly directed. With very fractious children it may even be necessary to have a second assistant hold the child's head. Failure to take pains in making a proper application of the swab is accountable for many of the unsatisfactory results obtained from cultures. The swab having been properly inoculated, the cotton stopper is withdrawn from the mouth of the tube containing the solidified blood-serum and the swab then rubbed gently over the surface of the culture-medium, care being taken not to break the smooth surface of the medium. The swab is then withdrawn, the cotton stopper, which must have been held so as to have escaped contamination from any outside source, replaced in the mouth of the culture-tube, the swab dropped into its tube again and confined by its own stopper. The culture-tubes are then ready for incubation. Koplik has described a rapid method of incubation and examination in which he allows only two or three hours' incubation at 37° C., at the end of which time he asserts that the growth of the diphtheria bacilli is more characteristic than at any other period of incubation.

There is no positive criterion by which the true diphtheria bacillus can be recognized in culture after twenty-four hours. The pseudodiphtheria bacillus is, culturally, practically indistinguishable from it, differing only in its lack of

virulence. Hoffman considers the pseudodiphtheria bacillus a constant inhabitant of the mouth. Roux and Yersin found it twenty-six times in fifty-nine children of a village on the coast of France in which diphtheria was entirely absent. Bech discovered it twenty-six times in sixty-six healthy children. In view of this, what value can a method possess by which, in the required time of twenty-four hours, it is impossible to distinguish the true diphtheria bacillus from a constant inhabitant of the mouth? The length of the bacilli has been frequently regarded a characteristic feature, but very long bacilli with all the qualities of the Loeffler bacilli, except that they were non-virulent, were found in the conjunctival sac. The true diphtheria bacillus in culture, especially on white of egg, exhibits a sort of giant-growth, and presents true branching, a phenomenon also observed in the growth of the conjunctival bacillus. In view of all these facts, it is plainly not possible to distinguish the virulent from the non-virulent bacillus, and too much importance should not attach to bacteriological diagnosis without determination of virulence, especially when the diagnosis is made within twenty-four hours. Schanz (Berl. klin. Woch., Jan. 18, '97).

The advantages of ox-serum as a culture-medium for the diphtheria bacillus are that the true bacillus can be easily distinguished from the bacillus of Hoffman, as the colonies of the former are flat, almost colorless, and indented at the edge somewhat like a daisy, while the colonies of the bacillus of Hoffman are elevated, brilliant white, do not adhere to the surface, and give no opalescence in the medium. However, it takes several days to get a characteristic culture, while with horse-serum a culture is obtained within six or eight hours. L. Cobbett (Lancet, Feb. 5, '98).

Upon blood-serum and agar the xerosis bacillus resembles closely the diphtheria bacillus. It is not pathogenic for animals. It grows more abundantly on Loeffler blood-serum and on peptone-agar than the pseudobacillus. Neisser's method of staining decolorizes the xerosis and pseudobacillus, while the diph-

theria bacillus retains the stain. Bouillon is rendered acid by the diphtheria bacillus, alkaline by the xerosis bacillus, and it is not affected by the pseudodiphtheria bacillus. E. Franke (Münch. med. Woch., Apr. 19, '98).

When there is no special reason for haste, it is usually more convenient to adopt the method followed by the New York Board of Health, of twelve hours' exposure, the cultures are kept at body-temperature over night and are ready for examination in the morning.

It is not possible to determine the presence or absence of diphtheria bacilli in the cultures upon the blood-serum from the gross appearances; but if it is found that the culture-medium has been liquefied during the incubation, it can safely be said that contaminating bacteria are present in such numbers as to render the culture valueless. The diphtheria bacilli or cocci do not liquefy the medium.

The true diphtheria bacilli do not grow in fluid antitoxic serum, nor do non-virulent pseudobacilli that render bouillon acid, while virulent organisms that render bouillon alkaline grow equally well in liquid antitoxic serum and normal serum. All forms grow excellently upon antitoxic serum that has been coagulated at 70 degrees. De Martini (Centralb. f. Bakt., Parasit., u. Infr., Jan. 30, '97).

Upon the centre of a clean cover-glass is placed a drop of sterile water. With a sterile platinum loop a number of the colonies, which show themselves as fine, granular elevations upon the culture surface, are swept off. The loop is then immersed in the water upon the cover-glass and its contents spread evenly over the glass. The preparation after being allowed to dry in the air is fixed by passing it three times through a moderate gas-flame. It is then stained by covering it with Loeffler's alkaline methylene-blue solution and allowing it to stand for ten minutes. The cover-glass is then

washed, dried, and mounted in Canada balsam.

The following is recommended as a differential stain for the diphtheria bacillus:—

(A) One gramme of methylene-blue (Grubler's) is dissolved in 20 cubic centimetres of 96-per-cent. alcohol, which is then mixed with 950 cubic centimetres of distilled water and 50 cubic centimetres of glacial acetic acid.

(B) Two grammes of vesuvin are dissolved in 1 litre of boiling distilled water and filtered.

The cover-glass preparations are stained in A for 1 to 3 seconds, rinsed in water, and stained in B for 3 to 5 seconds, washed in water, dried, and mounted. Stained in this manner, the bacilli are brown, and contain two, or rarely three, but never more, blue corpuscles. The corpuscles are oval, not round, in shape, and their diameter appears greater than that of the bacilli in which they are situated. Neisser (Zeitschr. f. Hyg., vol. xxiv, No. 3, p. 443, '97).

The examination is made with a $\frac{1}{12}$ oil immersion lens. In a large proportion of the cases we see an almost-pure culture of the diphtheria bacillus; next most frequently cultures of cocci, single double, or in chains; in some cases the cocci and bacilli are about equal in number, and in a small number only a few diphtheria bacilli are seen scattered among great numbers of cocci. From time to time we see in the cultures bacilli which closely resemble the diphtheria bacilli, but with certain definite points of distinction, and pseudodiphtheria bacilli. The diphtheria bacilli seen in such cover-glass preparations vary in length from 1.5 to 6.5 millimetres, and in diameter from 0.3 to 0.8 millimetres. They occur singly or in pairs, rarely in chains of three or four. The rods are straight or slightly curved and are not usually uniformly cylindrical throughout their length, but are swelled at the ends, or pointed at the ends and swelled

in the middle. The variety in size and shape even from the same culture is characteristic. When in pairs, the bacilli may lie with their axes in the same line or forming an acute or obtuse angle; sometimes they are crossed. The bacilli show no spores, but may contain highly-refractile bodies, especially in their swelled portions. When grown upon blood-serum and stained in the manner above described, the bacilli stain in a peculiarly-characteristic way. Lack of uniformity, both in the individual bacillus and in the numbers of groups, is marked. Thus, different parts of a bacillus take the stain unequally; so that the ends are dark blue, while the centre shows little or no color, or *vice versâ*. Likewise bacilli lying side by side show marked difference in coloring, one being much more deeply stained than the other. This lack of uniformity in the staining of the bacilli seems to belong to a certain period of their growth; it is usually marked after the twelve-hour incubation, but many disappear entirely in older cultures.

Mention has already been made of bacilli found in cultures resembling the diphtheria bacillus and yet not possessing the specific pathogenic properties of that bacillus, and therefore termed pseudodiphtheria bacilli. This term is most unfortunate, since these bacilli bear no relation to the throat inflammation termed pseudodiphtheria. As seen in cover-glass preparations, these bacilli are shorter, plumper, and more uniform in size and staining. They are most often met with in cultures from the nose. When obtained in pure cultures, these bacilli have been shown to be devoid of virulence.

As seen under the microscope, the uniformity in size, shape, and staining is sufficiently marked from the variations

in these points noted with reference to the diphtheria bacillus to enable practiced observers to recognize them readily.

In the diagnosis of diphtheria the simple microscopical method of examining the exudate is a great deal better than any clinical method. All that is needed is a good microscope, with an Abbé condenser and oil-immersion lens. Also a few slides are required, and some Löffler alkaline blue. If one meets with a suspicious case, all that is necessary is to ask for a whalebone or stout stick and wrap a bit of absorbent cotton on the end. This swab should be rubbed on the exudate very firmly; then it can be put in an envelope or other simple container and examined in the office. To do this, one should moisten a clean glass slide with a drop of water and rub the swab around in it for a minute. Then the swab should be burned and the preparation dried. When it is thoroughly dry, it is passed through a flame three times at such a rate that the exudate is baked and will not wash off. On the other hand, it should not be heated so that the preparation is distorted and scorched. After heating, one should run on the slide a drop or two of Löffler's blue, sufficient to cover the dried exudate, then wash off the stain, dry thoroughly with blotting-paper, and drop on a little cedar-oil and examine. The whole process takes about a minute or two.

If the case is diphtheria, the first thing that will attract the eye are masses of fibrin stained deeply blue. These masses are stringy in texture. In these masses of fibrin and outside peculiar bacilli may be seen. They are always more or less curved. They are never of perfectly even width. They are often clubbed at one or both ends, or they may taper at one or both ends. These organisms never take the stain evenly; the substance of the bacilli appears much denser in places, so that the organism appears to have bands or stripes. Bacilli often appear broken in the middle, or there seems to be an achromatic juncture.

But what is far more characteristic is

the presence of little black or bluish-black points very often situated at one or both poles of the bacillus, with occasionally a little point in the middle. If these point-bearing bacilli are found in the fibrin, one can be very certain that the case is diphtheria. There are many other organisms found in diphtheritic membrane by this method, but if they contain chromatin granules and are curved and irregular in outline, they are diphtheria bacilli. If the case is tonsillitis, by the same method single round cocci or streptococci or diplococci are to be found, but no chromatin point-bearing little rods will be seen.

A diagnosis of diphtheria should not be made unless these chromatin points are found. The preparation should be properly heated, and it is most important that the stain be good. A poor stain will not differentiate the chromatin points. Chromatin points appear in other organisms, as has been seen in long bacilli grown on potato and found in water, but the organisms were three or four times longer than the diphtheria bacillus; they were straight and of even width, except where the chromatin points bulged through the continuity, so that the organism resembled a jointed bamboo cane. It is said that a bacillus which is pathogenic for mice also exhibits chromatin spots. But it is rare to find such organisms in the throat, and much rarer to find them in pseudomembrane. R. L. Pitfield (Univ. of Penna. Med. Bull., Sept., 1901).

Whenever we find the characteristic bacilli above described present in the cover-glass preparations, we can safely set the case down as one of true diphtheria, however few the bacilli may be in number in the smear, or with whatever other bacteria combined. If the diphtheria bacilli are found at all, a second culture usually shows them greatly exceeding in numbers any other form of bacteria present, and the cases will be found to present the clinical symptoms of diphtheria.

In any case, to render the bacteriolog-

ical diagnosis complete, it would be necessary to obtain the diphtheria bacilli in pure culture and test their virulence by inoculation of susceptible animals.

In routine practice this is done by inoculating half-grown guinea-pigs with from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of their body-weight of a forty-eight hours' culture of the bacilli grown at 37° C. in simple nutrient or glucose alkaline broth. In carrying out such experimentation many precautions are necessary to render such work accurate and trustworthy. Much time and labor are consumed in the process. For our purposes it is sufficient to know that the great majority of those who have carried on such experiments under proper conditions with bacilli derived from pseudomembranes and presenting the morphological and staining characters of diphtheria bacilli have found the bacilli fully virulent.

So long as the bacteriological diagnosis is reinforced by clinical evidence of the presence of false membrane and the symptoms of diphtheria, we can safely trust to the examination of these cover-glass preparations.

We find, however, that the examination of healthy throats has led to some remarkable results. In the throats of those who have been exposed to diphtheria, but have remained perfectly well, we may find characteristic and fully virulent diphtheria bacilli; in others we may find the pseudodiphtheria bacillus already spoken of, or a bacillus which, while presenting the cultural and morphological characters of the diphtheria bacillus, proved in inoculations to be non-virulent.

Thus, in a series of 330 healthy throats examined by the New York Board of Health, in 8 virulent characteristic diphtheria bacilli were found, in 24 non-virulent characteristic diphtheria bacilli,

and in 27 non-virulent pseudodiphtheria bacilli. Since Hoffmann's observation of these bacilli, so closely resembling the Loeffler bacillus, but devoid of virulence, a great deal of attention has been given to this subject. Opinion is still divided as to the relation of these non-virulent bacilli. On the one hand, they are regarded simply as degenerate or attenuated forms of the diphtheria bacillus; on the other, they are represented as a distinct species.

The identity of the pseudodiphtheria bacillus seems to be now established. In form these are smaller, shorter, and thicker than the diphtheria bacillus. When seen in stained smears the bacilli are often observed to be lying parallel to one another, in contrast to the irregularly-angular disposition of the diphtheria bacillus. In their growth in broth the pseudodiphtheria bacilli develop alkali, where the Loeffler bacillus forms acid. They are never virulent. These differences are, by most authorities, considered sufficient to warrant the belief that they are a separate species.

The other class of non-virulent bacilli found in the throat present all the characters of the Loeffler bacillus except their virulence. Roux and Yersin believed these bacilli to be simply attenuated forms of the diphtheria bacillus. It was shown that they are particularly likely to be met with in the throats of those who have had diphtheria some time before, or have been exposed to diphtheria. It was also found that the diphtheria bacillus could be so attenuated by various methods of growth as to deprive it of its virulence. No one, however, has yet been able to restore virulence to any of the non-virulent forms met with, and the question must be considered as still open.

There are 70 varieties of diphtheria

and pseudodiphtheria bacilli from the standpoint of agglutination by anti-diphtheritic serum. This property is an inconstant characteristic of the true Klebs-Löffler bacillus, and is in no way related to its virulence. Certain varieties of this organism can be agglutinated by the serum of horses immunized by cultures, while they do not react to the serum of horses immunized by toxins. The pseudobacillus conducts itself toward these sera precisely as does the true organism, and by this means cannot be differentiated from it. Ch. Lesieur (*Comptes Soc. de Biologie*, Aug., 1901).

Etiology.—As early as 1879 Klebs is said to have observed the presence of a peculiar bacillus in cases of diphtheria. In 1883 his observations of the presence of this bacillus in the pseudomembranes from the throats of those dying of epidemic diphtheria were reported and brought to general attention. In 1884 Loeffler published the results of his observations. He had found the bacillus present in the great majority of cases diagnosed as diphtheria, had been able to obtain the bacillus in pure culture, had inoculated it upon the abraded mucous membranes of susceptible animals and thereby produced pseudomembranous inflammation, often followed by death; he had injected bouillon cultures of the bacillus subcutaneously and had found characteristic lesions after the death of the animals so treated. In 1888 d'Espine found the bacilli present in fourteen cases of typical diphtheria, and proved them to be absent in 24 cases of mild sore throat, not presenting the clinical characters of diphtheria. In the same year Roux and Yersin reported that they had found bacilli presenting the characters described by Loeffler in all cases of typical diphtheria. They showed that when inoculated upon the healthy mucous membrane of the trachea

of rabbits no effect was produced; but, if the membrane were previously abraded the symptoms of pseudomembranous laryngitis in men followed. Congestion of the mucous membrane, the formation of pseudomembrane, swelling of the glands and cellular tissues of the neck, dyspnoea, stridor, and asphyxia. From that time on numerous observations were made in France, Germany, and America, until, in 1891, Welch declared that all the conditions necessary to the demonstration of the specific relation of the Klebs-Loeffler bacillus to diphtheria had been met: (1) its constant presence in cases of true diphtheria, (2) its isolation in pure culture, and (3) the production of all the symptoms of the disease by the inoculation of pure cultures in susceptible animals. Since that time evidence has been accumulated from many sources, till there can no longer be any doubt that the essential cause of diphtheria is the growth and development of this bacillus within the body. The development of the disease must, therefore, be dependent in every case upon the presence and action of the diphtheria bacillus.

The disease is common in all parts of the land. In the cities it is usually endemic, the frequency and virulence of the disease varying from year to year; in rural communities it usually occurs as distinct epidemics, each new outbreak being dependent upon the introduction of the disease from without. It may also occur sporadically. It does not, however, in any case arise *de novo*. Each new case is developed by infection, however remote, from some previous one. The infection may be either direct or indirect. Direct infection is undoubtedly most common.

The bacilli are usually present in great numbers in the discharges from the

throat or nose of the patients, in the saliva, and in the membranes which may, from time to time, be coughed up. They are not, so far as evidence is had, present in the breath of the patients, but may abound in the air of the room or rooms inhabited by them. The bacilli have even been reported as present in the urine of patients.

The genitals of every female child who contracts diphtheria in its throat should be examined. Coues (Boston Med. and Surg. Jour., May 12, '98).

Direct contact with the discharges from the nose or throat of those suffering from diphtheria is most dangerous. Many a physician has fallen victim to diphtheritic infection received by allowing a child to cough in his face during the process of examination. Kissing the patients may likewise be the means of infection in many cases.

While severe cases are usually due to the action of virulent bacilli and may, therefore, be especially potent in transmitting the disease, it is not to be forgotten that apparently mild cases may harbor bacilli just as virulent and just as much to be avoided. As already remarked, the most virulent bacillus Park has met with was derived from a mild case of diphtheria. The cases of virulent pharyngeal diphtheria are most dangerous on account of the quantity of the discharge. Purely laryngeal cases have little or no discharge, and are consequently less likely to spread the infection.

The bacteria may linger in the throat for weeks after the disappearance of all clinical symptoms and the patients continue throughout the period to be sources of infection.

In 245 of 405 cases the diphtheria bacilli disappeared within three days after the complete separation of the false membrane; in 160 cases the diphtheria bacilli

persisted in 103 cases for seven days; in 34 cases for twelve days; in 16 cases for fifteen days; in 4 for three weeks; and in 3 for five weeks. In many of these cases the patients were apparently well many days before the infectious agent had disappeared from the throat. N. Y. Health Board (Annual, vol. i, '95).

Indirect infection may occur by means of the clothing of the patients, the bedding, carpets, wall-paper, draperies, eating- or drinking- utensils, tongue-depressors, swabs, instruments of any kind used upon or about the patient, anything that has come in contact with the infectious discharges. Children's toys or books are especially likely to be contaminated and become means of carrying the germs to others.

In some cases persons who are themselves perfectly healthy, but who have been in contact with diphtheria cases are found to harbor the bacilli in the nose or throat and may be the source of infection to others. On several occasions the development of a series of cases of diphtheria in a single nursery of the New York Foundling Hospital has led to the examination by cultures of the throats of all children in that nursery, with the result of usually finding two or three who, while apparently healthy, had typical germs in their throats.

The isolation of these children would at once break the succession of cases of diphtheria previously observed. It may also happen that physicians or nurses transmit the germs either by their hands or clothing from one case to another. The frequent occurrence of diphtheria in the families of physicians is sufficient evidence of the need of care.

[If diphtheria is suspected or ascertained, the physician should, before entering the sick-room, remove his coat and vest, and cover his body, neck, and extremities with a blouse or a sheet fastened around his neck and body.

When the physician has completed his examination, and is about leaving the family, he should bathe his head, face, beard, and hands in an antiseptic lotion, as one of corrosive sublimate or carbolic acid. All articles not required for the comfort of the patient, as carpet, curtains, pictures, and decorations, should be removed, and all persons except the physician and those who nurse the patient should be excluded from the sick-room. J. LEWIS SMITH and F. M. WARNER, Assoc. Eds., Annual, '94.]

Apart from the question of the transmission of the disease from case to case, many other factors may influence the development and spread of diphtheria.

Sex apparently has no influence, but age materially influences the susceptibility. Nursing children are, happily, remarkably immune. The greatest susceptibility lies between the ages of two and five years; from five to ten many cases are seen; after ten the susceptibility diminishes very rapidly, and in adults it is but slight. The following table of 14,688 deaths occurring in New York in ten years, tabulated by Billington, illustrates these points:—

Under one year.....	1,214
From one to five years.....	9,622
From five to ten years.....	3,212
From ten to fifteen years...	311
Over fifteen years.....	329

Total 14,688

The season of the year exerts some influence. Thus, in England and Wales the average number of deaths for each quarter of the year, from 1870 to 1893 inclusive, was as follows: First quarter, 1000. Second quarter, 819. Third quarter, 847. Fourth quarter, 1192. (Thorne.)

Diphtheria is, therefore, more common during the cold months of fall and winter than during the spring and sum-

mer. The same fact is borne out by Bosworth's analysis of 18,688 deaths from diphtheria occurring in New York during thirteen years. Of these 10,769 occurred from October to March, and 7919 from April to September, inclusive.

Result of an extended epidemiological inquiry into the incidence of diphtheria, during the twenty years of 1877-96, in the city of Catania (population in 1896, 116,000). During the nine years of 1877-85 the deaths per 10,000 at all ages were 15.8, while in the nine years of 1886-94 they fell to 7.1, and in the four years of 1893-96 they were only 2.7. These two nine-yearly periods were characterized by a sudden rise in the mortality and a slow decline, but the maximum in the first period (1879) was 34 per 10,000, while in the second period it was 16.

Taking the whole twenty years, the influence of season is very marked. The lowest month is August (4.8), and the highest is January (12.25); and taking the summer quarter as June, July, and August, it is 5.71; while the autumn and winter quarters are 10.9 each, and the spring 8.3. The meteorological elements which differentiate the seasons are temperature, relative humidity, and rain-fall. Taking the whole twenty-years' period, it is shown by curves of temperature, relative humidity, and rain-fall that the two latter agree directly with the diphtheria death-curve, while the first agrees with it inversely. The important consideration is the cause of this marked diminution in diphtheria mortality. Serum-treatment is virtually not practiced at all, and disinfection is little followed. It is in general sanitary improvements that the explanation is to be looked for. Giagunta (Gior. d. Soc. ital. d'ig., No. 8, '98).

The massing of children in schools, asylums, and hospitals produces conditions favorable to the development and spread of diphtheria, doubtless by increasing the chances of infection. The schools have often been pointed out as the sources of epidemics of diphtheria,

which could only be controlled by closing the institutions concerned.

Out of 654 convalescent hospital cases, the bacillus was found in 309 after the entire disappearance of the membrane. Among 107 of these, cultivations from the throat gave negative results for some days, and then the bacillus would reappear. Since the same fact was observed in discharged cases, this reappearance was hardly due to reinfection. The following list shows the time the bacillus was present:—

		Diphtheria Bacillus Present After Disappearance of Membrane.	
In	cases	from	1 to 10 days
"	93	"	" 10 to 20 "
"	51	"	" 20 to 30 "
"	41	"	" 30 to 60 "
"	6	"	" 60 to 120 "

Disinfectants for the throat had been carefully applied. The use of anti-diphtheritic serum did not prevent the persistence of the bacillus in the upper respiratory tract.

The virulence of diphtheria bacilli under these circumstances is illustrated as follows: A girl, aged 8, had a mild attack of diphtheria, and after two months in hospital was, at the request of her parents, sent home, though the bacillus was still present in the throat. A week after her return a companion living in the same tenement entered the hospital with a diphtheritic sore throat, though the bacillus was not found. Three days later, the sister of the first patient, and fourteen days later the sister of the second, were received into the hospital, suffering from diphtheria, in each of which the bacillus was found. A bacteriological examination of the first patient's throat eighty-four days after disappearance of the membrane showed that the virulent diphtheria bacillus was still present. Holger Prip (Zeit. f. Hyg. u. Infectsk., B. xxxvi, H. 2, 1901).

The following section from the Bulletin of the New York Board of Health is of interest in this connection:—

"It has been the practice of the Department to plot upon a city map the location and date of every case of diphtheria in which the diagnosis had been

settled by bacteriological examination. After several months the map presented a very striking appearance. Wherever the densely settled tenements were located, there the marks were very numerous, while in the districts occupied by private residences very few cases were indicated as having occurred. It was also apparent that the cases were far less abundant, as a rule, where the tenements were in small groups than in the regions of the city where they covered larger areas. At the end of six months there were square miles in which nearly every block occupied by tenement-houses contained marks indicating the occurrence of one or more cases of diphtheria; and in some blocks many (15 to 25) had occurred.

"As the plotting went on, from time to time the map showed the infection of a new area of the city, and often the subsequent appearance of an epidemic. It was interesting to note two varieties of these local epidemics: in one the subsequent cases evidently were from neighborhood infection, while in the second variety the infection was as evidently derived from schools, since a whole school-district would suddenly become the seat of scattered cases. At times, in a certain area of the city from which several schools drew their scholars, all the cases of diphtheria would occur (as investigation showed) in families whose children attended one school, the children of the other schools being for a time exempt."

A number of epidemics have been traced to infected milk, the infection arising from the presence of diphtheria among those engaged in handling the milk. Certain English observers have also claimed to have discovered a specific disease among milch cows, characterized by an eruption of vesicles and pustules upon the udders and teats, accompanied

by the presence of the diphtheria bacillus in the local lesions, and capable of being reproduced by infections of the bacilli.

Other outbreaks of diphtheria have been attributed to bad drainage, defective sewers, or the presence of an abundance of decomposing organic matter. It is also held that certain domestic animals—pigeons, cats, etc.—are susceptible to diphtheria and may be the means of transmitting it to man.

However much or little insanitary surroundings may contribute to the development of diphtheria, the active and essential cause must be the diphtheria bacillus, and our hope of limiting the ravages of this disease must be based upon control of the individual cases, each of which is a focus for the farther spread of the infection.

The tenacity to life of the bacillus outside the body is remarkable. Hofmann found that it would live for one hundred and fifty-five days on blood-serum; Loeffler and Park for seven months; and on gelatin Klein found it living after eighteen months. On bits of dried membrane found living bacilli after fourteen weeks, Park after seventeen, and Roux and Yersin after twenty weeks. Abel says that, dried on silk threads, they may live one hundred and twenty-two days and upon a child's plaything, kept in a dark place, he found the bacilli alive after five months.

The period of incubation of diphtheria varies from two days to a week. It is doubtless affected by the number and virulence of the organisms present and by the resisting power of the patient. In most cases it is impossible to determine the time of exposure, much less that of infection. Second attacks of diphtheria are rare, but do occur. In one case observed at the New York Foundling Hospital, a boy of 4 had crop in March.

The diphtheria bacilli were demonstrated in cultures from the throat. Antitoxin was given and he recovered. Twenty-five days later, having been apparently well in the meantime, he developed tonsillar diphtheria, which extended to the larynx, pneumonia developed, and death followed, thirty-four days from the conclusion of the first attack.

Pathology. — The bacteriological investigations of recent years have materially affected our views of the pathology of diphtheria. We have learned that the local lesions of the mucous membranes really constitute a very subsidiary part of the process. In them the diphtheria bacilli grow and multiply, developing in their growth certain organic substances, termed toxins, which are readily absorbed into the circulation and by their action produce constitutional symptoms and remote affects more characteristic of the disease than the local lesions themselves. The diphtheria bacilli have been found not only upon the mucous membranes, but in the lungs, liver, spleen, lymph-nodes, kidneys, and even upon the valves of the heart. They are not, however, present in great numbers in any of these organs; in fact, they are, except possibly in the case of the lungs, so few in number as to be demonstrable only by means of cultures. Their presence in the viscera does not excite characteristic lesions of these parts, and seems to be an accidental accompaniment rather than an essential part of the disease. The action of the toxins, on the other hand, is characteristic and important. These substances have been isolated and studied especially by Brieger and Fraenkel, Roux and Yersin. They have been found to be allied to the albumins, and have been designated as toxalbumins. In experimental inocula-

tions in susceptible animals, as shown by Welch and Flexner and others, they have been found to produce all the characteristic features of diphtheria except the membrane, especially the characteristic post-diphtheritic paralysis. The most striking of their remote effects are produced in the lymph-nodes and liver. In the lymph-nodes they produce a distinct hyperplasia; in the liver necrosis or death of small areas of liver-cells, focal necroses, similar to those seen in the liver in typhoid fever and other infectious diseases.

We must, therefore, believe that the presence of these soluble poisons in the circulation constitutes a very important feature of diphtheria. These toxins, as already noted, are elaborated in the local lesions of the mucous membranes, and not by the bacteria that may be present in the various viscera. The quantity and quality of the toxins generated seem, as a rule, to be proportionate to the severity of the local process.

The following results are reached from a study of the constitution of the diphtheria poisoning: 1. The diphtheria bacillus produces two kinds of substances: (a) toxins and (b) toxons, both of which combine with the antitoxin. Toxins and toxons have been found in three fresh bouillons in the same quantitative relation. 2. The toxins, and probably also the toxons, are not simple bodies, but they break up into various subdivisions, which differ in their affinity for the antitoxin. Three groups can be distinguished: prototoxins, deuterotoxins, and tritotoxins. 3. This division does not exhaust the complication, for it must be assumed that each species of toxin consists of exactly two equal parts of different character, which have the same relation to the antitoxin, but differ in their destructive influence. They probably differ from each other like dextrorotatory and levorotatory substances. 4. One of these constituents is called x-modification, and this is readily transformed in

all toxins into toxoids. This transformation begins already in the incubator. Owing to the disappearance of one-half of the poison, the complete metamorphosis into toxoid causes a semivalent toxin to remain, called hæmatotoxin. 5. The second modification, beta-modification, is in the different species of poisons, prototoxins, deuterotoxins, and tritotoxins of variable permanency. The beta-modification of the deuterotoxins is the most stable. This explains the fact that after a time diphtheria-bouillon reaches a stage of definite toxicity that is permanent; whence only those poisons that have entered this state should be used as diseased toxins. 6. In the change of toxin into toxoid the affinity of the antitoxin is not in the least modified, and the toxoid of the prototoxin, for example, binds the antitoxin in the same way as the prototoxin itself does. The varieties of poisons combining less promptly with the antitoxin are less readily destroyed by the latter than those that combine with it more promptly. 7. Regarding the significance of the L_0 and the L_+ dose, it is to be noted that the L_0 dose is subject to greater variation than the L_+ dose. 8. The facts developed are best explained by assuming that in the toxin-molecule two independent atom-complexes are present. One of these is haptophorous, which causes the binding of the antitoxin to the corresponding lateral chain of the cells. The other is toxophorous; *i.e.*, the cause of the specific action. The same is true of the toxons. 9. The haptophorous group is responsible for the combination of the toxin-molecule with the cells and thus of rendering the latter amenable to the influence of the toxophorous group. 10. The effects of the haptophorous and toxophorous groups can in certain cases be separated experimentally. Morgenroth has shown that the nervous system of the frog fixes tetanus-poison in the cold; disease-phenomena do not arise under these circumstances. If the frogs, which have been treated at proper intervals, first with poison and then with antitoxin, are placed in the incubator, tetanus develops even when all the circulating poison has combined with the

antitoxin, and even when the latter is present in excess. The haptophorous group thus acts already in the cold, the toxophorous only after the application of heat. 11. The temporal difference in the action of the haptophorous and toxophorous groups explains also the incubation period. 12. The toxophorous group is more complicated and less permanent than the haptophorous. The anti-bodies produced by the influence of the poison act exclusively on the haptophorous group. By combining, through the mediation of this haptophorous group, with the entire toxin-molecule, they prevent the toxophorous group from acting upon the organs. 13. The specific antitoxin can also be produced with toxoids, but the immunity cannot be used to procure curative serum. The toxons probably play an important rôle: In natural immunity, *i.e.*, in the form in which, not the poisons isolated, but the causative agents themselves are the factors. Toxoids are decomposition-products of the prepared toxin. 14. It is probable that prototoxins also are, under certain circumstances, capable of bringing about a direct cure, by displacing the poison from the tissue-elements by reason of their stronger affinity for the latter. Paul Ehrlich (*Deut. med. Woch.*, Sept. 22, '98).

CATARRHAL DIPHTHERIA. — As we have already seen, the local effects of a diphtheritic inflammation vary greatly. In catarrhal diphtheria we see simply redness and some swelling of the mucous membrane of nose, throat, tonsils, or larynx, usually with an increased secretion of the mucous glands. None of these would show macroscopically in the rare cases, when death follows such a process. Oertel has, however, found in these cases degeneration of the epithelial cells of the mucous membranes similar to those seen in pronounced cases of diphtheria.

THE DIPHTHERITIC MEMBRANE. — The membrane is most frequently seen upon the tonsils, soft palate, uvula, pharynx,

nares, larynx, trachea, or bronchi. In severe cases it may appear upon the lips, especially at the angles of the mouth, the buccal mucous membrane, and the tongue. Very rarely it appears in the œsophagus, stomach, or intestines. In fact, the freedom of the œsophagus, when the diphtheritic membrane may be seen completely covering the pharynx and tonsils and extending throughout the whole respiratory tract even to the terminal bronchi, is most remarkable. Even in the severest cases the membrane usually stops abruptly at the beginning of the œsophagus.

It is also possible to observe a true diphtheritic membrane upon abraded cutaneous surfaces; upon wounds, as in tracheotomy; or upon the conjunctiva or the genital mucous membrane. The color of the membrane may be white, gray, greenish white, yellow, or more or less black, when there has been hæmorrhage from the affected surfaces. It may be thick and elastic, so as to be stripped off in sheets, or thin and diffuent. The thicker membrane is observed upon the surfaces covered with columnar epithelium, with a definite basement-membrane, such as the nose, larynx, trachea, and bronchi. Here, too, it is but loosely attached; so that it is often thrown off in casts during life, or after death may easily be stripped off from the underlying surfaces. Upon the tonsils, pharynx, uvula, and fauces, where the epithelium is of the squamous variety and without a basement-membrane, the diphtheritic membrane is much more closely attached. Often in these situations we see, after death, no distinct membrane, but a diffuent exudate, which may be easily washed off, leaving a distinctly-ulcerated surface beneath.

Microscopically the membrane or exudate is found to consist chiefly of fibrin,

mingled with epithelial cells from the mucous membrane, pus-cells, red blood-cells, granular material, and bacteria. The superficial parts of the membrane are granular in character, while beneath we find a more or less distinct net-work of fibrin, inclosing within its meshes the cells, granular material, and bacteria. The bacteria are the diphtheria bacilli together with streptococci or staphylococci, and rarely pneumococci. The inflammatory process may be superficial or may extend irregularly into the mucous membrane, in some cases involving the submucous tissue and even the muscular coat. The bacteria may likewise penetrate deeply into the tissues, but are usually most abundant in the superficial parts of the membrane. The epithelial cells of the mucous membrane undergo degeneration, their protoplasm becoming granular, their nuclei fragmented, and the cells ultimately breaking up into granular material. The pathological process is, therefore, a coagulation-necrosis involving the mucous membrane more or less deeply.

The pseudomembrane is cast off in masses or is gradually disintegrated, with more or less destruction of the mucous membrane. The process of separation is usually attended by a more abundant cellular exudation beneath the pseudomembrane. Except in the gangrenous cases apart from the tonsil, in which there may be extensive destruction of the tissues, the integrity of the mucous membrane is completely restored, leaving no traces of the preceding disease. Gangrene is not properly a part of the diphtheritic process, but is brought about either by especially-unfavorable conditions affecting the vitality of the patient and by the invasion of unusually-virulent bacteria other than the diphtheria bacilli, probably the streptococci.

The seat and distribution of the membrane vary greatly in different cases. The point of importance with reference both to symptoms and prognosis is the involvement of the larynx. Of 1000 cases analyzed by Lennox Browne, the larynx was involved in 159, in only 4 of which number was the affection limited to the larynx. In a similar analysis of 109 cases by Holt, the larynx suffered in 46, in 10 of which the disease involved either the larynx, or the larynx with the trachea or bronchi. Holt gives no purely nasal cases in his series; 2 are given by Browne. In the great majority of cases the membrane is found upon the tonsils or the adjacent parts, the pharynx, uvula, and pillars of the fauces. Six hundred and seventy-two of Browne's 1000 cases showed such distribution.

Since extension of the membrane usually increases the severity of the case and the probability of death, the clinical records of Browne show the comparative frequency of the various forms better than tables which are largely formed from autopsy records. Laryngeal cases are also much more frequently met with in children's hospitals or asylums than in dispensary or private practice.

In cases involving the nasal cavities the process is often catarrhal, and there may be no macroscopical lesion after death. In many such cases, however, there may be membrane in the rhinopharynx, the adenoid tissue of the vault of the pharynx being a favorite seat of the disease. When membrane is developed in the nose, it is usually thick and but loosely attached; so that it may readily be thrown off as casts of the nares.

Upon the tonsils the membrane may be found only in the crypts, resembling a follicular tonsillitis, or it may be in scattered patches, or may completely

cover the surface. It is closely adherent. The tonsils are swelled and may even meet in the median line. In most cases the membrane spreads to the surrounding parts: the pharyngeal walls, the fauces, or uvula. The epiglottis is also frequently involved in these cases, even when the larynx is not affected. The membrane often extends into the rhinopharynx and thence may pass to the Eustachian tubes and the middle ear. Upon the uvula or fauces the membrane is usually thicker and more loosely attached than that upon the tonsils.

The uvula is swelled and œdematous. The epiglottis, if involved, is swelled and thickened and one or both surfaces may be covered with membrane. After death the membrane upon these parts does not show as clearly as during life, and we are apt to find a more or less marked ulceration of the parts. The epiglottis frequently shows considerable destruction of the mucous membrane. Microscopically the pathological process may extend deeply into the submucous or even the muscular coats of these parts, but the ulceration rarely extends beyond the superficial epithelium. In cases where the membrane appears upon the pharyngeal walls it will be found to stop short at the level of the cricoid cartilage, the œsophagus being perfectly normal.

The appearances in the larynx are quite different from those met with in the throat. The laryngeal process may be simply catarrhal, even when there is abundant membrane in the throat and there have been marked laryngeal symptoms; so that the larynx after death may appear normal, or there may be a slight congestion of the mucous membrane and the vocal cords after death. In other cases we see a finely-granular deposit upon the cords and mucous membrane, and the ventricles of the larynx may be

filled by a yellowish-white exudate, but there is no distinct membrane. Again we may see a distinct membrane masking the cords, obliterating the ventricles, and covering the mucous membrane below. When there is either exudate or pseudomembrane present in the larynx, it is rarely limited to that part, but will be found to extend into the trachea and

bronchi, and even the lungs. In the trachea we may see scattered areas of membrane, or the membrane may line the whole extent of the respiratory tract. There is usually a much more distinct membrane in the trachea than in the larynx itself. Upon these surfaces the membrane is but loosely attached; so that it may be coughed up in complete



Diphtheria of tonsils, larynx, trachea, and bronchi. At upper end the tonsils and base of tongue are seen. The tonsils showed superficial ulceration, covered by thin membrane. Epiglottis is thickened. Right ventricle of larynx filled by exudate and obliterated. From left vocal cord hang some shreds of membrane. Immediately below vocal cords membrane completely covers larynx and trachea. Lifted on the skewers it contracts to a rope-like strand, which is seen extending to finest bronchi on right side. Both lower lobes of lungs consolidated by pneumonia.

casts of the bronchial tree, or after death may be readily lifted from the underlying tissues (see illustration).

In a series of autopsies upon 87 cases of laryngeal diphtheria made by one of us (Northrup) the distribution of the membrane was given as follows: In 9 cases the membrane extended from the tip of the nose to the finest bronchi; in 6 from the nose to the bifurcation of the trachea; in 17 from the pharynx to the finest bronchi; in 17 from the larynx to the finest bronchi; in 17 from the pharynx to the main bronchi; in 17 in the larynx and trachea; in 3 in the pharynx and larynx; and in 1 in the larynx only. This work was done in the preantitoxin days, and it must be said that in the autopsies made since the introduction of antitoxin such extensive distribution of membrane is but rarely met with.

Pseudomembrane may be found in the stomach or intestines, but is rarely, if ever, produced in these situations by the action of the diphtheria bacillus; streptococci are usually found. Occurring upon the conjunctiva, the lips, buccal mucous membrane, or the tongue, the diphtheritic membrane does not present any unusual features.

Case of diphtheritic stomatitis observed in a child of 4 years, who for several days had suffered with slight pseudomembranous stomatitis represented by three small patches on the end of the tongue. The condition proving rebellious to local treatment, bacteriological examination was made, and almost pure cultures of Klebs-Loeffler bacillus were obtained. Under the influence of 20 centimetres of antitoxin the case yielded in four days, the pseudomembrane coming away just as in pharyngeal cases. Mongour (Treatment, Apr. 14, '98).

Upon abraded skin surfaces or upon wounds, — especially the tracheotomy wound in laryngeal cases, — the mem-

brane may be pronounced, and is usually reproduced with remarkable rapidity after removal.

Case of diphtheria of the umbilicus observed in a child 14 days old. The Klebs-Loeffler bacillus was found in the pus from the umbilicus. The child gradually weakened and died within two days. Examination after death showed larynx and pharynx normal. The local lesion had not extended to other organs. Bernard Pitts (Lancet, Apr. 3, '97).

In puerperal infection in most instances the streptococcus pyogenes is found to be the morbid agent, but it is, however, not infrequent for the Klebs-Loeffler bacillus to be discovered in the discharge from the uterus; and in these cases it is probably the source of infection. Longyear (Amer. Jour. of Obst., Oct., '97).

Two cases of diphtheria in the vulva. Diphtheria of the vulva may occur primarily, or secondarily with clinical and bacteriological diphtheria of the throat. W. P. Coues (Boston Med. and Surg. Jour., May 12, '98).

Apart from the lesions produced by the diphtheria bacilli at or by extension from the site of inoculation, they appear to produce no other direct effects, although they may be found present in the viscera. Their toxins, on the other hand, produce definite and characteristic visceral lesions. The experimental work of Welch and Flexner, Abbott, and others has served to make known these remote effects of the toxins. In the great majority of cases of human diphtheria, other bacteria, especially streptococci, are present and active besides the specific bacilli; they are mixed infections, and the problem of determining the action of any one organism is greatly complicated. In forty-two autopsies in cases of diphtheria in which the Loeffler bacillus had been demonstrated during life, Reiche is reported to have found streptococci and staphylococci in the kidney or spleen, and streptococci alone in 45.2 per

cent. Streptococci were found in the kidney in one case which died on the second day, and positive results were also obtained on the third and fourth days. The results obtained by experimental inoculation of the toxins in susceptible animals are, therefore, much simpler and more easily interpreted than examinations of the viscera of fatal cases of human diphtheria. The lesions produced by the toxins are found in the lymph-nodes, liver, kidney, spleen, heart-muscle, the peripheral nerves, and lungs.

The red corpuscles of the blood in diphtheria undergo a diminution in number in cases of moderate severity and in severe cases. Regeneration is slow.

The leucocytes are increased in number in all but two classes of cases: exceptionally-mild cases and exceptionally-severe ones. As a rule, the amount of leucocytosis is directly proportionate to the degree of severity of the case. The leucocyte-curve shows no correspondence to the clinical course of the disease. The leucocytosis is similar in character to that seen in pneumonia and scarlet fever, the increase being in the so-called polynuclear forms.

The percentage of hæmoglobin falls coincidentally with the number of the red corpuscles and to the same relative degree. But the regeneration of the hæmoglobin takes place much more slowly than that of the red corpuscles.

In cases treated with antitoxin the diminution in number of the red corpuscles is much less marked than in those cases treated without it; in a majority of the cases no such diminution takes place. The leucocytes are apparently unaffected by the antitoxin. The hæmoglobin is also much less affected in the cases treated with antitoxin, thus confirming the statement as to the red corpuscles.

In healthy subjects injected with antitoxin the red corpuscles show a very moderate reduction in number in about one-half the cases. The hæmoglobin is correspondingly affected. The leucocytes are apparently unaffected by the injections.

It is improbable that any information of prognostic importance is to be gained by examination of the blood in diphtheria. J. S. Billings, Jr. (*Med. Record*, Apr. 26, '96).

The blood in 24 children suffering from diphtheria examined with a view to determining the effects of antitoxic serum. In 21 cases, when examined before the injections, a manifest hyperleucocytosis was found, the degree of which varied between 1 to 71 and 1 to 275. This leucocytosis was not in relation with either the age of the child or the elevation of temperature presented at the moment of the examination; the influence of the gravity of the affection upon the leucocytosis was not constant, but, in general, the degree of hyperleucocytosis was more marked the graver the case. Hyperleucocytosis diminished as the case proceeded to recovery, but persisted in the cases terminating in death.

The influence of an injection of serum was manifested at first by a diminution of hyperleucocytosis, followed at the end of some time by an increase in the number of leucocytes, which did not always attain the degree observed before the injection. Schlesinger (*Archiv f. Kinderh.*, B. 19, S. 378, '96).

Welch and Flexner have shown that these visceral lesions are produced either by injections of pure cultures of the diphtheria bacillus or by inoculation of their toxins.

The lymph-nodes—cervical, bronchial, mesenteric, axillary, and inguinal—are found to be swelled. There are hæmorrhages either beneath the capsule or into the substance of the glands. The cells show more or less advanced degenerative changes both in their nuclei and in the cell-protoplasm. The nuclei are fragmented; the cell-bodies are converted into a finely-granular, reticulated material, apparently fibrinous. Similar changes are observed throughout the lymph-structures of the body, Peyer's patches, solitary and agminate follicles of the intestines, etc. The changes

in the lymph-nodes rarely lead to suppuration.

The spleen is swelled and usually softened. There may be hæmorrhages beneath the capsule or into the substance of the organ. The follicles are enlarged and the cells show degenerative changes similar to those seen in the lymph-nodes. The liver shows hæmorrhages either upon its surface or within its substance. There may be an advanced fatty degeneration of the liver. There are also found minute areas in which there has been produced a necrosis of the liver-cells, the nuclei being fragmented or having completely disappeared, while the bodies of the cells show advanced degenerative changes. Some of these areas are infiltrated by leucocytes. Similar focal necroses in the liver have been observed by other poisons than the toxins of diphtheria.

The changes in the kidney include a degeneration of the epithelium of the tubes and glomeruli and hyaline alteration of the glomerular capillaries and smaller arteries. The severe affections of the kidney, acute exudative or diffuse nephritis, met with as complications of the later stages of the disease, are attributable rather to the accompanying streptococcus infection than to the diphtheria itself.

The heart shows a fatty degeneration of its muscles, sometimes so advanced as to produce changes in every fibre. The nuclei of the muscles may also be fragmented.

The changes produced in the brain-cells of animals inoculated with diphtheria toxins have recently been made the subject of study (Carlo Ceni; Berkeley). Swelling of the processes of certain cells of the brain with some minor changes in the conformation of the cells, but without evidence of degeneration of

the cells or their processes, was observed. The cerebral were more affected than the cerebellar cells.

Various lesions have been found in the spinal cord in cases of diphtheritic paralysis, but none of the changes observed in the cord have thus far been accepted as the explanation of the paralysis.

Katz has recently reported finding, after careful examination of the cords of three fatal cases, distinct changes in the motor ganglion cells of the anterior horns of the cord. The changes were either a fatty degeneration affecting the cells or complete death of the cells with all processes, and especially the axis-cylinder. All ganglion cells of the cord were similarly affected, but not so markedly as the motor cells of the anterior horns.

The changes in the peripheral nerves, on the other hand, are looked upon by some as the most characteristic pathological lesion of diphtheria. The affected nerves are sometimes red and swelled, from congestion and œdema, but the degeneration of the nerve-fibres is the characteristic feature of the process. Single nerve-fibres or a whole nerve-trunk may be affected. The changes may be either interstitial or parenchymatous. In the parenchymatous form there is usually a more or less marked infiltration of leucocytes within the nerve-sheath, between the sheath and the nerve-fibres, or between the fibres themselves. The medullary sheath of the nerve-fibre is swelled, undergoes a fatty degeneration, and may altogether disappear. The axis-cylinder undergoes a similar degeneration; it may be changed to a granular mass and be completely absorbed. The empty sheaths of Schwann may be the only evidence left of the former nerve-fibre. Sooner or later the degeneration stops; regeneration begins and usually

results in complete restoration of the nerve-fibres. In the interstitial form the increase of the connective tissue of the endoneurium and perineurium is the marked feature of the process. In some cases the changes are both parenchymatous and interstitial.

A study of the changes in the nervous system due to the action of diphtheritic poison shows: 1. A marked parenchymatous degeneration of the peripheral nerves, sometimes accompanied by an interstitial process and hyperæmia and hæmorrhages. 2. Acute diffuse parenchymatous degeneration of the nerve-fibres of the cord and brain. 3. No changes, or but slight ones, in the nerve-cells. 4. Acute parenchymatous and interstitial changes in the muscles, especially the heart-muscle. 5. Occasional hyperæmia, or infiltration, or hæmorrhage in the brain or cord, in rare cases severe enough to produce permanent troubles, such as the cases of multiple sclerosis and of hemiplegia which have been observed. 6. The probability that the cases of sudden death from heart-failure in diphtheria, during the disease or convalescence, are due to the effects of the toxic substances produced in the disease upon the nerve-structures of the heart. J. J. Thomas (Boston Med. and Surg. Jour., Feb. 10, '98).

Four cases observed in which the diphtheria bacillus was found in the blood and in the nervous centres. In one case the germs had entirely disappeared from the throat, but were found in pure culture in the bulbar centres. Paralysis was absent. Richardière (*La Rev. Méd.; Pediatrics*, May 1, '98).

Forty per cent. of the post-diphtheritic palsies are confined to the palate, and in 12 per cent. the palate and eye muscles are affected. The pharynx may be the only part involved, or it may be in conjunction with other parts, near or distant. The muscles of mastication are very rarely involved. Felt (*Medical News*, Feb. 14, 1903).

The pulmonary changes produced by the experimental action of diphtheria bacilli or their toxins are slight and of no

importance, but the pulmonary complications of clinical diphtheria are frequent, severe, and of great moment. Wright, More, Kanthack, Stephens, and others have demonstrated the presence of diphtheria bacilli in the lungs in fatal cases of diphtheria, but the presence of the bacilli apparently has but little to do with the production of pulmonary complications. In 1889, in an investigation of a series of seventeen cases of pneumonia complicating diphtheria, Prudden and Northrup found streptococci both in the pseudomembranes in the throat and in the lungs. It was further shown that the inoculation of streptococci in susceptible animals served to produce changes in the lungs similar to those seen in clinical diphtheria. These observations have been fully corroborated, and the streptococci are accepted as the active agents in the production of the pneumonia which so frequently complicates diphtheria. Broncho-pneumonia is met with in the great majority of fatal cases, especially in hospital practice. In the most acute cases we find the posterior parts of one or both lungs deeply congested, firm to the touch, and on section showing scattered areas of peribronchial consolidation, deep red in color. The lower lobes are usually more affected than the upper. In the slower cases we find the areas of pneumonia scattered throughout both lungs, but affecting the lower and posterior portions especially, the consolidation often involving a large part of both lungs and on section appearing mottled, reddish-brown and yellowish-white. Pleurisy and empyema are rarely met with. In laryngeal cases with marked stenosis there is usually emphysema, both vesicular and interstitial. The interstitial emphysema may involve the cellular tissues of the neck and even extend over the trunk.

Prognosis.—In no other acute infectious disease is the prognosis so uncertain as in diphtheria. Many factors must be taken into consideration in determining the prognosis in any given case.

1. Age of the patient. Happily children under six months of age are rarely attacked; but between that age and two years many cases are seen, and the mortality is often frightful. With increase in age the mortality falls steadily, but even in adult life diphtheria may readily prove fatal.

The following tables taken from the article of Biggs and Guerard in "The Use of Antitoxic Serum," show the favorable influence of age very clearly:—

Herz: Mortality Percentage.

0-1 year.....	80.00
1-3 years.....	45.00
3-5 years.....	40.00
5-10 years.....	17.00
Over 10 years.....	17.00

Hirsch: Mortality Percentage.

0-1 year.....	83.3
1-3 years.....	82.5
3-4 years.....	63.9
4-5 years.....	46.9
6-7 years.....	43.2
Over 7 years.....	22.2

Baginsky: Mortality Percentage.

0-2 years.....	63.3
2-4 years.....	52.8
4-6 years.....	37.9
6-10 years.....	24.6
10-15 years.....	14.6

The ratios are all derived from cases treated previous to the introduction of antitoxin or without its use. The analysis of a large number of cases treated by antitoxin, while the mortality-ratios are diminished, shows that the age influence remains practically the same.

Age.	Cases.	Deaths.	Mortality Percentage.
0-2 years.....	1494	469	31.4
2-5 years.....	3678	762	20.7
5-10 years.....	3184	473	14.8
Over 10 years..	1444	99	6.9

The subcutaneous injection of saline solution in a child with diphtheria may throw light on the prognosis. If after giving the injection, the child voids more urine without vomiting or diarrhœa, the diphtheria will run a mild course, no matter how stormy the onset. But if the amount of urine is not increased, and there is vomiting or diarrhœa, the prognosis is grave, as the toxins have affected the heart-fibres, and the organ is thus unable to respond to the action of the saline solution. Rabot (*Bull. Méd.*, Sept. 4, 1901).

2. The site of the disease. Involvement of the larynx either primarily or secondarily adds greatly to the danger of the case. The large death-rate under two years is due, in great part, to the strong tendency of the disease to invade the larynx during that period.

The use of antitoxin has materially changed all the figures relating to the fatality of the various forms of diphtheria, but the laryngeal process remains the most deadly.

Influence of antitoxin on the death-rate of the three principal Australian colonies. In Queensland the mean annual death-rate per 100,000 living from 1884 to 1889 was 42.9. From 1890 to 1894, 44.1; from 1895 to 1898 (the antitoxin period), 14.4. In New South Wales the mean annual death-rate per 100,000 living from 1884 to 1889 was 43.2; from 1890 to 1894 it was 47.7; from 1895 to 1898 (the antitoxin period), 18.4. In Victoria the mean annual death-rate per 100,000 living from 1884 to 1889 was 45.4; from 1890 to 1894, 39.8; from 1895 to 1898 (the antitoxin period), 19.7. J. Turner (*Brit. Med. Jour.*, Nov. 18, '99).

There has been a decline in the mortality of diphtheria in Prussia since 1894 that cannot be explained by the improvement of sanitary conditions. From 1885 to 1894 the death-rate from this disease averaged 15.5 per cent. to every 10,000 of the population. It fell in 1895 to 9 per cent., and in 1896 to 7.6 per cent.; in 1897 to 6.2 per cent. This points to the general adoption of the antitoxin

treatment of diphtheria in private as well as hospital practice. A. W. Willoughby (Therapist, July, '99).

From October 5, 1895 (the date of the first administration of antitoxin by the department), to February 28, 1899, a total of 6343 reported cases of diphtheria were visited by the Chicago departmental inspectors. Of this number 4311 were bacteriologically verified as true diphtheria, and 4076 treated with antitoxin. Results show 3795 recoveries out of the 4076 cases treated by the department. There were 276 deaths, and 5 cases were still under treatment at the close of February, 1899. The figures of recoveries, 3795, and of deaths, 276, give a mortality-rate of 6.77 per cent. in 4071 cases of bacteriologically verified diphtheria treated with antitoxin. In 355 cases treated on the first day of the disease there was only 1 death, a mortality of only 0.28 per cent.; in 1018 cases first treated on the second day there were 17 deaths, a mortality of 1.67 per cent.; in 1509 cases first treated on the third day there were 57 deaths, a mortality of 3.77 per cent.; in 720 cases first treated on the fourth day there were 82 deaths, a mortality of 11.39 per cent.; and in 469 cases first treated later than the fourth day there were 119 deaths, a mortality of 25.37 per cent. The death-rate of 6.77 per cent. from diphtheria during the past three years, since antitoxin has been used, shows a decline of 43 per cent. as compared with that for the previous three years, when other methods of treatment were in vogue. (Bull. of Dept. of Health, Chicago, Feb., '99; Amer. Jour. Med. Sci., p. 86, '99).

Deaths from diphtheria in New York have declined from over 2000 in 1892 to 1087 in 1898, and the mortality from 36.7 per cent. in 1891, and 40.6 per cent. in 1892, to 13.1 per cent. in 1899, and 12.2 per cent. in 1898. Antitoxin was given free of charge to 1902 patients in 1899, with a mortality of 12.3 per cent., or with 91 moribund cases deducted 7.8 per cent.; 1093 patients were immunized in the first 9 months of 1899, and among these only 6 cases of diphtheria occurred after twenty-four hours and within thirty days. Fewer cases

would probably have occurred after immunization if 300 units instead of the usual dose of 150 units had been given. Billings (N. Y. Med. Jour., Feb. 17, 1900).

Letter sent to a number of physicians, of whom 673 replied. Of these, 622 were favorable to antitoxin, 26 expressed no opinion, and only 5 were opposed to it. The total number of cases reported was 12,375, the recoveries being 11,727, a percentage mortality of 5.23. Correspondence with health officials of both foreign and American cities shows the mortality to be 38.4 per cent. in 183,256 cases before the antitoxin period. The mortality in 132,548 cases since the antitoxin period was 14.6 per cent. Edwin Rosenthal (Jour. Amer. Med. Assoc., Aug. 1, 1900).

The value of antitoxin treatment in diphtheria is clearly demonstrated in the returns of the Metropolitan Asylums Board. In 1894, 3042 patients of all ages were treated in the Board's hospitals without antitoxin; 902 died, yielding a mortality of 29.6 per cent. In 1895 the antitoxic serum treatment was inaugurated; 3529 cases of diphtheria were treated, and 729 died, yielding a mortality of 22.5 per cent. Hence in the first year there was a fall in mortality of 7.1 per cent. From the "Annual Report of the Metropolitan Asylums Board" for 1901, recently issued, it appears that, in 1901, 6499 patients suffering from diphtheria were treated with antitoxin in the Board's hospitals; 817 died, yielding a mortality of 12.5 per cent. There has, therefore, been a fall in mortality percentage from 29.6 in 1894, without antitoxin, to 12.5 in 1901, with antitoxin. In other respects the treatment has been substantially the same. The laryngeal cases treated in 1901 with antitoxin numbered 753, and there were 159 deaths, which gives a mortality percentage of 21.1. It has long been known that early administration of antitoxin is important if its real advantages are to be gained. But it would be difficult to furnish more concise or convincing evidence of this well-known fact than the tables printed in the Asylums Board Report from Dr. MacCombie's results at the Brook Hos-

pital. During the year 723 cases of diphtheria were treated with antitoxin, and 78 died, yielding a mortality percentage of 10.79. The antitoxin treatment was applied in each of these cases, but in some it was possible to begin on the first day of the disease, in others on the second, and so on. The paramount importance of administration at the earliest possible moment is seen in the result. The mortality percentage of the first-day cases (38) was 0.0; of the second day (170 cases), 4.1; of the third day (192 cases), 11.9; of the fourth day (137 cases), 12.4; and of the fifth and subsequent days (186 cases), 16.6. For five consecutive years there has not been a death at this hospital among the cases that came under treatment on the first day of the disease, and of those coming under treatment on the second day of the disease the mortality has not exceeded 5.4 per cent. These figures afford striking evidence of the value of antitoxin, and particularly of its early administration. Editorial (Brit. Med. Jour., March 14, 1903).

3. The time of beginning treatment. In the use of antitoxin it has been demonstrated beyond the shadow of a doubt that, the earlier the remedy is employed, the surer is recovery, while after the fifth day the remedy exerts little or no influence. It has always been clear that delay in undertaking treatment led to unfavorable results, but the vital necessity of promptness has been impressed upon us by the overpowering evidence afforded by the results obtained when antitoxin is resorted to early in the case.

4. The degree of toxæmia. This feature is usually developed in proportion to the lapse of time from, and the severity of, the onset of the disease. It may be slowly or rapidly developed, and in many cases apparently mild in the beginning we may later see the severest types of toxæmia.

Conclusions regarding leucocytosis in diphtheria: 1. After a massive dose the

number of polynuclear leucocytes describes a curve of parabolic form, with its height twelve to sixteen hours after the inoculation, and increasing rapidly and regularly until death. 2. In slight intoxication the course of the polynuclears is represented by an oscillatory curve. 3. In the course of immunization leucocytic reaction is very manifest, particularly during the first hours after the injection. 4. Animals which have been saved by antitoxic serum from massive doses of toxin show the same oscillation in the polynuclear leucocytes as in mild cases of intoxication. 5. Children recovering from diphtheria show polynuclear leucocytosis lasting from twelve to fifteen days. 6. If the course of the disease is irregular, or if phenomena preventing a cure supervene, the blood shows a decided correlation between polynuclear leucocytosis and the gravity of the disease. 7. Cases going on to a fatal termination in spite of serum show the characteristic polynuclear leucocytosis. The degree of polynuclear leucocytosis after the injection of antitoxic serum constitutes one of the surest elements of prognosis in diphtheria. Besredka (Ann. de l'Institut Pasteur, May, '98).

Researches made on the blood of 26 patients suffering from diphtheria; their ages varied from five and one-half months to eight years; 24 of them had the fibrinous form and 2 only had the phlegmonous, and they all recovered. Observations were always made in the evening at the same hour, and always from three to four hours after the injections, when these were being given. In all the cases leucocytosis was present in greater to less degree, and without relation to the temperature and age of the patient; neither was it possible to discover a constant relation between the intensity of the morbid process and the leucocytosis. The leucocytosis, however, increased with the increase of the malady, and only began to decrease after the complete absorption of the exudate. The injection of antidiphtheritic serum caused an increase in the leucocytosis. Antonio Marioltini (Pediatrics, Aug., '99).

5. The extent of the membrane and the rapidity of the extension.

6. The presence of complications, especially from broncho-pneumonia or nephritis. The pneumonia of diphtheria is by far the most important of the complications.

The late onset of the cardiac complications of diphtheria is to be remembered. No case of severe diphtheria can be considered altogether out of danger for some weeks after apparent recovery.

7. The surroundings of the patient. The mortality of diphtheria is considerably greater in hospitals or asylums for children than in private or dispensary practice. The crowding of the children together seems to exert a very unfavorable influence by exposing them to danger from complications, and most especially to pneumonia.

8. The mortality of diphtheria may vary greatly from year to year in the same place or in different epidemics, the causes of the variation not being apparent. Such variations in the type of the disease may properly be taken into account in the prognosis of individual cases.

The author turns to the figures of the committee of the American Pædiatric Society, embracing 5576 cases of diphtheria (moribund cases excluded), collected principally from the private practice of American physicians, including two rather short series from the hospitals of New York and Chicago. The mortality was 8.8 per cent.

Cases injected upon the first day gave a death-rate of 4.9 per cent.; upon the second day, 8.6 per cent.; upon the third day, 12.7 per cent.; upon the fourth day, 22.9 per cent.; and after the fourth day, 38 per cent. The result of this report compares favorably with any that has been published in this country or in Europe.

To illustrate the importance of the need of the early administration of the antitoxin, Baginsky's figures are even

more striking. Cases injected upon the first day give a death-rate of from 1.07 per cent. to 2.7 per cent. Cases injected upon the second day give a mortality of 5.7 per cent. to 14.1 per cent. The study of these and other figures has led to the following conclusions:—

1. Under the use of antitoxin the death-rate has been reduced, in round figures to about 16 per cent., against a former death-rate of from 65 per cent. to 25 per cent. In favorable circumstances the mortality is 8 per cent. or lower.

2. The death-rate varies greatly according to the promptness with which the remedy is given. It falls to 3 or 5 per cent. in cases injected upon the first day, and increases rapidly until it reaches 35 or 40 per cent. in cases in which injection has not been made before the fourth day or after.

Results in hospital practice are much less satisfactory than those in private practice. The reason for this is probably that in former case the patients are seen and injected earlier, probably come from better hygienic surroundings, and show correspondingly greater resistance. J. D. Steele (St. Louis Med. and Surg. Jour., Oct., 1901).

Study of 10,526 cases of diphtheria showed that the ratio of mortality of diphtheria per 10,000 of the living was very high in Boston previous to 1895. The ratio of mortality per 10,000 has been very materially reduced since the introduction of antitoxin. The percentage of mortality in the "South Department" (Boston City Hospital) is lower than that of any of the hospitals at home or abroad taken for comparison. Since larger doses of antitoxin have been given the death-rate has been materially reduced, this reduction having occurred in the apparently moribund cases. No injurious effect has followed the use of serum. To arrive at the most satisfactory results in the treatment of diphtheria, antitoxin should be given at the earliest possible moment in the course of the disease. J. H. McCollom (Providence Med. Jour., July, 1902).

In the wards of the Mülhauser Hospital the average mortality was above

50 per cent.; for 1895 it was 38 per cent., and for 1896 it was 28 per cent. During these two years the serum was used in small quantities and not in all cases. In 1897-98-99 and 1900, when the serum was used freely, the mortality ranged between 15 and 20 per cent. The effect of the injection of the serum seemed to be beneficial. When the patients had fever, it usually decreased rapidly. All the patients that required tracheotomy required it upon admission, excepting two in whom it was done the day after admission. In one case of albuminuria the serum injection caused it to disappear at once.

The causes of death were various: paralysis of the heart, pneumonia, etc. One patient died shortly after admission to the hospital, and one of diphtheria of the bronchioles. The dose of serum varied from 600 to 1500 units, repeated at intervals as appeared necessary. In addition, the children received gargles containing potassium chlorate, and when there was much pain they were allowed to swallow small pieces of ice. In the severe cases the throat was painted with a solution of ferric chloride. The nourishment was of the most concentrated character. In no case was any spread of the diphtheritic process observed after the injection of the serum. Jaeger (*Deutsches Archiv f. klin. Med.*, Bd. lxxiii, 1903).

Prophylaxis.—In typical diphtheria we have to deal with an acute infectious disease, in which we now know the nature of the contagion and its ways of spreading. The bacilli present in the nose or throat of the patients are the active agents, and anything which may either directly or indirectly be contaminated by the discharge from the affected surfaces may be the means of communicating the disease to others. The first step in prevention is, therefore, the isolation of the diphtheria patient. Suspected cases should be isolated as thoroughly and promptly as those in which the diagnosis is settled. It is to be re-

membered that during epidemics or in any case of exposure many of the mild cases of "sore throat" are, in reality, diphtheria, and should be treated as such in this respect.

Moreover, as has previously been noted, diphtheria bacilli may be found in the throats of those who, although perfectly healthy, have been exposed to infection. This is especially true of children, and in families where diphtheria is present the well children should be kept from attendance at schools or like gatherings where they may possibly convey the disease to others more susceptible than themselves. In the course of epidemics it is often necessary to close all schools before the ravages of the disease can be controlled. The past year has been marked by the establishment in our large cities of a system of inspection by trained physicians of all school-children who present the first symptoms of illness: a progressive step in preventive medicine that will undoubtedly do much to protect these communities from epidemics of diphtheria. Suspected cases of diphtheria are to be isolated, but should not be put into diphtheria wards or hospitals until the diagnosis is assured. Our reliance must be upon the bacteriological diagnosis, for in case of exposure the mildness of the individual case is no surety that it is not dangerous to others.

These cases call for especial care, both in making and in examining the cultures. With proper methods, twenty-four hours should suffice to settle the question of diagnosis. In case of doubt the isolation of the patient should be continued and the bacteriological examination repeated.

In all our large cities provision is now made for the treatment of diphtheria in special public hospitals. To these hospitals are sent all cases that cannot be properly cared for and isolated at home.

New York has recently added to her equipment a private hospital for the treatment of contagious diseases, including diphtheria. Here patients who are able to pay for their care are received as private patients. The institution is thoroughly equipped and ought to materially aid in the proper isolation of contagious cases among the classes of people whose aversion to the public hospitals has often led them to disregard the instruction and even the edicts of the health officers.

Proper isolation of diphtheria cases developing in hospitals or asylums, especially those for children, is of very great importance, since these institutions contain the most susceptible material for the action of diphtheria bacilli. They should be provided with diphtheria wards, located, if possible, in separate buildings. The isolation of such wards should be complete. In no other way can the inmates of such institutions be protected from repeated outbreaks of diphtheria.

In private houses one or more rooms should be set apart for the use of a diphtheria patient. No one but the patient and the attendants should be allowed to enter the sick-room. All expectoration, bits of membrane, etc., should be received in cups containing a solution of carbolic acid, 1 to 40, or bichloride of mercury, 1 to 1000. Instead of handkerchiefs, bits of gauze or old linen should be used, and burned when soiled. All bedding and clothing used during the attack should be soaked for several hours in a 1 to 40 solution of carbolic acid and afterward boiled. All eating utensils should be sterilized by boiling. Nothing that has been in the room should be taken from it without subjecting it to sterilization in some way.

The physician in charge of a case of diphtheria before entering the sick-room should cover his clothing by a cotton or

rubber gown reaching to the feet. The gown should be kept outside the sick-room and should be sterilized at the conclusion of the case. The physician should remember that, in examining the throat in cases of diphtheria, he stands in great danger of infection by having the patient cough in his face. Many a life has been sacrificed by careless exposure in this way. As a measure of protection, the physician is often advised to have a pane of ordinary window-glass held before the patient's face during inspection of the throat. Few men willingly adopt a cumbersome device which at the same time interferes with the examination; but, in case the patient does cough during the examination, the physician should protect himself by thoroughly washing the face and hair with soap and water, and then using a solution of bichloride, 1 to 1000. The hands should always be washed and disinfected on leaving the patient's room.

Nurses caring for diphtheria patients should especially avoid contracting the disease by exposing themselves to the discharges from the nose or throat of the patient. Practically there is no danger from the breath of the patient. The nurse should keep her hands thoroughly clean at all times and should have a disinfecting solution of carbolic or bichloride at hand so that she may use it constantly. A cleansing gargle of normal salt solution, Dobell's solution, or Seiler's solution should be used several times a day. Many advise the administration of an immunizing dose of anti-toxin (300 to 400 units) at the beginning.

If this is not done at that time, anti-toxin in protective dose should be given at the first sign of a "sore throat."

After leaving a diphtheria case the nurse should thoroughly disinfect both

her clothing and her person. It is also customary to require the nurse to allow a period of at least five days to pass after leaving a case of diphtheria before assuming charge of any other patient.

Antitoxin should be administered to all persons who came in contact with a patient developing diphtheria. Out of 546 children in the families of diphtheria patients examined by the author, 157 had Klebs-Löffler bacilli in their throats. Besides, out of 30 adults examined, parents and nurses, 13 had bacilli in their throats. Fourteen cases occurred, on the other hand, in which contagion was due to convalescents who had left the hospital with bacilli in their throats. Antitoxin, prophylactically given, caused no accidents. When diphtheria follows in spite of antitoxin, the dose may have been too small or the injection given too late. Of 502 children injected prophylactically, 13 developed diphtheria, 7 of them inside of twenty-four hours after the injection, the other 6 in the next twenty-eight days. The throats of 476 of these were examined, bacilli being found in 150. A great amount of statistics show the efficacy of antitoxin. The immunity lasted from two to twenty-eight days. When diphtheria occurred in inoculated children, it was mild. It is much like vaccination in effect, only the immunity to small-pox conferred by vaccination lasts much longer. Netter (*La Presse Médicale*, April 23, 1902).

LENGTH OF QUARANTINE.—The bacteriological researches of recent years have given us some very definite information bearing on this point. It has already been noted that the bacilli may persist in the throat for weeks after an attack, and that such bacilli have been proved fully virulent. Park reports a series of careful observations upon the time of the disappearance of the bacilli from the throat in 1736 cases of diphtheria. Briefly, he found that the bacilli had disappeared within 1 week in 3 per cent. of the cases, in $\frac{1}{3}$ of the cases at

the end of the second week, in $\frac{2}{3}$ at the end of the third week, in $\frac{4}{5}$ at the end of the fourth week, and in the remainder the bacilli persisted for varying periods up to 91 days. This last case was one of simple nasal discharge containing diphtheria bacilli, from which both nurse and mother contracted diphtheria. The mildness or severity of the case gives no basis for determining the time that the bacilli may remain in the throat. The only accurate method of determining the period of quarantine is that of making cultures from the throats. Only when cultures fail to show the presence of the bacilli in the throat or nose can the case be regarded entirely devoid of danger to others. If cultures cannot be employed, we may elect an arbitrary period of three weeks from the disappearance of membrane for the removal of quarantine restrictions. After that time, if the bacilli have not actually disappeared from the throat, they are but few in number and the danger of communication is slight.

Disinfection of the infected rooms upon the termination of the case should be thorough. The walls and ceilings are to be scrubbed with bichloride, 1 to 1000, or rubbed down carefully with bread: a simple method of removing the clinging dirt and bacteria by mechanical means. The wood-work, floor, and furniture are to be scrubbed with bichloride. The wood-work, walls, etc., are to be repainted or papered anew. Carpets, upholstery, etc., can be disinfected by steam. Clothing, linen, etc., may be boiled. Anything which cannot be disinfected by some of these means should be burned. Books and toys that children have used during their illness should be thus destroyed. Even the most careful disinfection will in some cases prove ineffective.

Apart from these measures with respect to the cases already developed, much may be done to prevent the spread of diphtheria by properly caring for children who may be exposed to infection. Catarrhal conditions of the nose and throat undoubtedly afford a favorable soil for the location and growth of diphtheria bacilli. Enlarged tonsils and adenoid growths in the naso-pharynx fall in the same category. All such conditions should be carefully treated.

Healthy mucous membranes are a safeguard against attacks of diphtheria.

IMMUNIZATION BY INJECTIONS OF ANTITOXIN.—By the injection of small doses of antitoxin it has been found possible to induce an artificial immunity which holds good for a period of at least four weeks, as a rule. Epidemics of diphtheria in children's hospitals or asylums have been repeatedly checked by protective injections of antitoxin in all the children exposed.

The value of immunizing injections in hospitals upon 254 children of ages varying from 2 months to 14 years observed, these observations covering a period of twenty-one months. The strength of serums varied from 100 to 3000 units, and the dose from 1 to 10 cubic centimetres. In the beginning, when the injections were made only upon patients in beds near to those which had been occupied by the diphtheritic patients, 4 cases of infection occurred. When, however, the injections were made upon all the patients of the ward, and, later, upon all patients subsequently admitted, the disease did not reappear, except in 3 cases thirty to forty days after injection, twice in children readmitted to the hospital, and once with a child that had been discharged well and returned at the end of a month with an attack of the disease. Two children admitted, but not injected on account of the gravity of their condition (pleurisy, articular rheumatism), contracted diphtheria and

1 of them died. On account of the 3 cases of infection developing one month after prophylactic injection, the injections were repeated monthly upon children who remained for any length of time in the hospital. After this plan was adopted no new case of diphtheria developed in the ward. Another series of immunizing injections was made in the measles ward upon 99 children. Of this number there were 21 cases that died, all of them under 1 year of age; but in no case was there diphtheria or croup.

In the Children's Hospital of Boston, of 1808 patients immunized at least once every twenty-eight days, the amount of serum varying from 150 to 500 units, 7 had diphtheria, 3 from insufficient dosing, 2 within twenty-four hours of the injection, and 2 in whom the time of infection came twenty-three and twenty-two days, respectively, after giving an amount which had previously been effective when given every three weeks. Of 829 who were not given antitoxin, or in whom more than twenty-eight days elapsed after the injections, 9 had diphtheria, besides 3 immunized adults. Immunity in any given case, of no matter how thorough exposure to diphtheria, may be conferred for at least ten days by the injection of a small dose (100 to 250 units) of serum, provided it is given twenty-four hours previous to actual infection. A larger dose (250 units for a child of two, up to 500 units for one of eight or over) will confer safety for three weeks under similar conditions. Morrill (Boston Med. and Surg. Jour., Mar. 3, '98).

Prophylactic use of antitoxin will furnish an effective means of lessening the number of cases. In over a thousand cases immunized only six contracted the disease, which was in every instance mild in form. It is better to use 300 units in children and 500 units in adults to immunize against the disease. J. S. Billings (N. Y. Med. Jour., Feb. 17, 1900).

As diphtheria antitoxin is practically harmless, all exposed persons should receive an immunizing dose in proportion to age. Two hundred and fifty units should be given to children under two years and 500 to all others. The im-

munity will last for at least three weeks, provided a reliable antitoxin is used. All exposed persons should be removed from infected surroundings, either by thorough disinfection of their own quarters or by removal to other places. If this be impossible, the immunizing doses should be repeated every third week. H. D. Jump (Phila. Med. Jour., Jan. 11, 1902).

In the article on the "Use of Antitoxin" by Biggs and Guerard previously quoted, a summary of thirty-five reports covering 17,516 injections of antitoxin for the purpose of immunization is given. Following these injections, 131 cases of diphtheria developed, 109 mild cases and 1 fatal case within thirty days of the date of injection; 20 mild cases and 1 fatal after thirty days. The writers state that "the duration of immunity after injection has not been definitely determined and undoubtedly varies. Some hold the opinion that it lasts only one or two weeks, others that it extends over thirty days or more. Four weeks may probably be considered as the average duration." The results certainly justify the further trial of this method of protection.

General Measures.—First of all, the sick-room should be well lighted and ventilated. Care in this respect is especially necessary in children's hospitals. Crowding a number of cases of diphtheria together in one ward is undoubtedly harmful. It is much better to have a number of small wards, accommodating three or four patients, than one large one in which all are assembled together. Cases in which pneumonia has developed should not be kept in the room with those still free from it. Attention should be given to feeding the patients, as the best means of enabling them to bear the attack of the disease upon the vital powers. Usually, on account of the soreness of the throat, fluid foods can be best

taken, but semisolids can be given in some cases. Our chief reliance must be upon milk. It should be given at regular intervals, every two hours, and in such quantity as the patient will take. There is little danger of overfeeding. The difficulty is usually to get the children to take sufficient nourishment. In addition to the milk, we may give beef-juice, beef-tea, or thin gruels. In children that have been intubated semisolids can sometimes be taken better than fluid nourishment. Bread and milk answer the purpose in such cases.

Nursing children should be fed with milk drawn by a breast-pump. In this way the children are saved the exertion of suckling and the mothers are protected from the danger of infection.

In septic cases the children often refuse food altogether or vomit it immediately it is taken. They may then be fed by the stomach-tube. If the tube cannot be passed through the mouth, we can usually succeed in passing it through the nose. This method may also be employed in intubated cases where the attempt to swallow food is followed by violent coughing or choking.

Rectal feeding with peptonized milk is a last resort, and seems to be of little value in children.

Rest in bed is an essential feature of proper treatment. Whatever handling or interference is required should be so arranged as to tax the patient as little as possible. Zeal for thorough local treatment has often led to fatal excitement and exertion on the part of the patient. Especially in cases of cardiac weakness should absolute quiet be enjoined, and all treatment that tends to excite the child or cause it to struggle avoided. Opium or morphine may be used to insure quiet under these circumstances.

Steam inhalations have long been employed for the purpose of increasing the secretions of mucus from the mucous membranes, softening the diphtheritic deposits, and hastening their separation. The croup-kettle has almost become a household utensil. To increase the efficacy of the steam, carbolic acid, turpentine, eucalyptol and other aromatic antiseptics have been added to the boiling water. These measures are of doubtful value at any time, and when they are employed under a close canopy at the sacrifice of fresh air, as is usually the case, may be positively harmful. The testimony of adults is that, at least, the steam is very comforting.

Convalescents should use disinfectant gargles for a considerable period. Good results are obtained by the constant employment of a disinfectant vapor, as eucalyptus, turpentine, carbolic acid, creasote, or tar. Either of these agents is added to water in a convenient vessel, and is constantly simmering by a moderate heat underneath. Mildly detergent and antiseptic gargles, such as diluted carbolic acid, boric acid and water, thymol, menthol, wintergreen, or bichloride of mercury (1 to 10,000) should be frequently employed by all persons exposed to diphtheria, as the nurse, physician, and the patient himself. Beverly Robinson (*N. Y. Med. Jour.*, Aug. 5, '94).

Local Treatment.—The local treatment in diphtheria is of importance.

The object sought in such treatment has changed considerably within recent years. We no longer seek to remove the membrane by local applications or by mechanical means, nor do we expect to destroy the bacilli in the throat. Experience has taught us that we can get rid neither of membrane nor of bacteria by local treatment, and also that too energetic efforts to accomplish these ends do harm instead of good. We have, therefore, abandoned the mechanical removal

of the membrane, the application of destructive powders or solutions to it, and the use of strong antiseptics to the affected parts. We endeavor simply to keep the nose, mouth, and throat clear of the secretions which may either obstruct them or by their decomposition and absorption increase the toxæmia.

To this end we employ bland fluids, such as normal salt solution, or a saturated boric-acid solution. The method of using the solution must be varied to suit each particular case. The most efficacious is undoubtedly the fountain-syringe. To employ this, we need only the douche-bag fitted with a smooth glass nozzle adapted to the size of the nares. The child is wrapped in a blanket so that the arms and legs are controlled. It is then laid upon its side on a table beneath the douche, the nozzle inserted on one side the nose, and the fluid, which should be lukewarm, allowed to flow freely for a moment. As it escapes from the mouth or the other nostril, it usually carries with it considerable quantities of mucus, or muco-pus, and possibly bits of membrane. The injection is repeated till the escaping fluid is clear. Sprays are ineffective, and should not be used.

This treatment should be employed every two or three hours during the height of the disease, less often as the amount of secretion lessens, but it should not be given up until the bacteria have disappeared from the throat.

Instead of this apparatus, we may employ a simple nasal syringe. The best form in our judgment is the "bulb nasal syringe with hard-rubber pipe" made by Whitehall, Tatum & Co., of New York. It consists of a simple rubber bulb, resembling that of a Davidson syringe, fitted with a blunt hard-rubber tip adapted to the nose. Being emptied by compression, it is much more easily han-

dled than piston-syringes. With one or the other of these apparatuses, nose and throat can be washed in practically all cases. The greatest care should be taken not to injure the mucous membrane in this treatment. Every abrasion affords a new site for the action of the diphtheria bacilli.

Severe nasal hæmorrhage may be a contra-indication to the continuance of this measure. Cardiac weakness may also forbid it, if the child struggles against it. A well-trained and skillful nurse should be able to carry out this treatment with very little tax upon the strength of the patient. In some cases, however skillfully it is done, the children fight against it so fiercely as to render its continuance inadvisable.

In diphtheria cases which have been subjected to frequent irrigation with antiseptic solutions from the beginning of the disease, the bacilli disappear far more rapidly than in those in which such irrigations have not been employed. Occasionally, when culture-tubes are inoculated immediately after irrigation of the throat with antiseptic solutions the cultures do not show any Loeffler bacilli, although subsequent examinations may demonstrate their presence. N. Y. Health Board (Annual, '95).

In one series of cases irrigation with warm salt solutions every one to three hours was employed; in a second series same treatment plus spray every three hours of pyrozone, from 5- to 25-per-cent. solution; in a third series irrigation by 1 to 3000 or 4000 solution of bichloride of mercury. Warm salt-water irrigation best to remove membranes, but bacilli disappear most rapidly under corrosive sublimate, or, what is equally good, a solution of boric acid, a tablespoonful to a pint of water; latter solution used without salt-water. Berg (Med. Record, Jan. 12, '95).

Case of faucial, nasal, and aural diphtheria in a child, aged 3 years, in which autoreinfection of the fauces took place from the ear, which continued to run

after the first attack of faucial diphtheria, in which the diphtheria bacilli were found after recovery from second faucial attack. The ear lost all symptoms of disease under the instillation of formalin solution (1 to 1000). C. H. Burnett (Phila. Polyclinic, May 21, '98).

Sodium sozoiodolate successfully used as an insufflation in a particularly severe case of diphtheria. The insufflations were made half-hourly, and usually consisted of equal parts of flowers of sulphur and sodium sozoiodolate. During the hoarseness, a mixture containing 0.025 gramme of pilocarpine hydrochlorate in infusion of digitalis (3 to 1000) was administered in teaspoonful doses. Neumann (Aerztl. Rund., viii, p. 523, '98).

Where there is much swelling of the cervical lymph-nodes, hot or cold applications may be used. Heat is preferable in infants; in older children the ice-cap may be used. Flannel pads or spongopylin wrung out of hot water, or poultices, may be used in the former case.

General Treatment.—With the advent of antitoxin most of the remedies for diphtheria have passed from use. A few still occupy a position which warrants some attention. In the treatment of pharyngeal or tonsillar diphtheria the tincture of the chloride of iron has long been regarded as of great value. Jacobi commends its use, advising a daily allowance of 1 drachm for a child 1 year old, 2 or 3 drachms for children from 3 to 5 years old. It is to be given diluted with water and glycerin. He admits that it cannot be tolerated by some patients and that alcohol is to be preferred in septic cases. Under present conditions its use must, therefore, be very limited.

In the treatment of laryngeal diphtheria the best results previous to the use of antitoxin were attained by the administration of mercury. The drug was given internally in the form of the bichloride, or the patient was treated by

calomel fumigations. The bichloride was given in hourly doses to the amount of $\frac{1}{6}$ to $\frac{1}{2}$ grain in twenty-four hours, each dose being preceded and followed by copious draughts of water. This treatment was continued for from four to eight days, and good results were claimed for it.

Calomel fumigation was a more elaborate process. A tent or canopy was rigged over the patient's crib. Beneath this tent 15 grains of calomel were volatilized every two hours for two days and nights, then every three hours for the third day, every four hours for the fourth day, and thereafter three times a day according to indications. The patients sometimes suffered from stomatitis and diarrhoea and developed pronounced anæmia; not infrequently the attendants were salivated; but this form of treatment gave better results in intubated cases than any other employed before the introduction of antitoxin.

Among other remedies that have been recommended, pilocarpine, guaiacol, citric acid, sodium hyposulphite, and myrrh have received the greatest attention; but the fact must be borne in mind that, in the majority of cases treated, the diagnosis has not been established by bacteriological examination.

Pilocarpine a precious auxiliary; less dangerous for children than for adults. Degle (*Wiener med. Presse*, Dec. 9, 16, '94).

Pilocarpine a specific in diphtheria. C. F. Howe (*Med. Brief*, Aug., '95).

In severe cases of diphtheria a beginning may be made by injecting a quarter of a syringe of a 2-per-cent. solution of pilocarpine, and then, to keep up the action of the drug, it may be given by the mouth. If there is no improvement at the end of twenty-four hours, another injection is given. M. S. Barsky (*Wratsch*, Nos. 45, 48, '95).

Guaiacol used early seems to destroy the bacilli and prevent the spread of the

pseudomembrane. Bacteriological examination of cultures taken from the same throat before and after its application has shown in the first instance the bacilli, and in the second none have been found. The formula is guaiacol, 10; menthol, 1; sterilized olive-oil, 10. The same application is of service as a prophylactic against diphtheria by application to the throat of the healthy inmates of the house in which the disease has appeared. This has been proved in two epidemics. In folliculous tonsillitis it is capable of cutting short the disease if early and thoroughly applied, and even in parenchymatous tonsillitis mitigates considerably the severity of the affection. S. Solis-Cohen (*Phila. Polyclinic*, No. 16, p. 157, '96).

One hundred and fourteen cases of diphtheria treated with a 10-per-cent. solution of citric acid given by the mouth. Eleven deaths occurred: a mortality of 9.6 per cent. Fifty-six of the cases were mild, 27 were of very doubtful prognosis, and 31 were decidedly grave. Four of the deaths were due to sepsis, 1 patient died after tracheotomy, and 1 died of paralysis of the heart during convalescence. Of the 11 who died, as many as 5 were not brought to the hospital until the disease had been running for from four to seven days. According to the patient's age a teaspoonful to a tablespoonful of the solution was given every two hours. In the beginning and in severe cases smaller doses are given, but more frequently, as often as every half-hour day and night. Bloch (*Ugeskrift for Læger*; *Deutsche med.-Zeit.*, Aug. 10, '96).

A solution of sodium hyposulphite as a local application in diphtheria gives good results, three or four applications generally being sufficient to clear away the false membrane. The solution is prepared for use by mixing equal parts of pure glycerin and a saturated solution of hyposulphite of sodium in water, and is applied with a brush to the exudation and inflamed fauces once or twice daily, or as often as may be deemed necessary. H. A. Wickers (*Lancet*, June 6, '96).

The internal use of tincture of myrrh

in diphtheria recommended. E. Graetzer (Münchener med. Woch., No. 47, S. 1164, '96).

Tincture of myrrh in diphtheria very strongly recommended. The mixture is composed of tincture of myrrh, 4 parts; glycerin, 8 parts; and distilled water, to 200 parts. This is given very frequently,—every hour or even every half-hour in the day-time and every two hours at night,—infants up to the age of 2 years taking a large teaspoonful (75 minims), older children double that quantity and adults three times as much. This is continued until the membrane has nearly disappeared, when the doses are only given every two hours. After all the membrane has gone the treatment is continued for a couple of days, the interval between the doses being increased to three hours. In the case of older children and adults a gargle containing $\frac{1}{2}$ -per-cent. resorcin may be employed every hour or oftener in the day-time and where it is desired the tonsils may be painted every hour with the tincture of myrrh undiluted. Where the larynx is involved the myrrh-and-glycerin mixture in an inhaler or spray to be used every half-hour. By this method only one case out of eighty has been lost, and reports collected from several other practitioners show 182 cases with 22 deaths. Ströhl (Lancet, Jan. 1, '98).

STIMULANTS.—These are required in every case of diphtheria showing any marked degree of constitutional depression, most of all in septic cases. The pulse and the general condition of the patient are the guides in their administration.

The best of all is, undoubtedly, alcohol. A child of three or four years can take at least 1 ounce of whisky or brandy in twenty-four hours. It should be given diluted with from 4 to 6 parts of water. In the severe cases the quantity of alcohol may be increased to several times the amount named above. It is best to give it apart from the food, as the patient may decline to take the stimulant, and

may be led to refuse the food because of its admixture. Next to alcohol, strychnine is of most value. The $\frac{1}{100}$ part of a grain may be given every two or three hours to an infant one year old; twice that amount to a three-year-old. The drug may be pushed till the deep reflexes show an exaggeration. Digitalis and like cardiac stimulants may be called for by the condition of the heart, but most reliance is to be put in alcohol and strychnine.

Antitoxin.—The antitoxin treatment of diphtheria has been in general use the world over for the past three years, and in that time has won for itself the right to be regarded as a specific.

[The history of the introduction of the diphtheria antitoxin may be found in Welch's article in the "Transactions of the Association of American Physicians" for 1895, page 313, and in brief in the article on "Diphtheria" in volume i of the ANNUAL OF THE UNIVERSAL MEDICAL SCIENCES for 1896.]

The antitoxin is derived from the blood of horses that have been subjected to repeated inoculations of increasing doses of the toxins produced by the diphtheria bacillus. The course of treatment usually occupies several months. When immunity has been thoroughly established in a horse, the blood is drawn from a jugular vein into sterilized vessels and allowed to clot. The clear serum is then siphoned off into small sterilized bottles, each of which contains sufficient antitoxin for one dose and is preserved by the addition of camphor or carbolic acid in small quantity. The antitoxin thus prepared is a clear, limpid fluid, having the color of blood-serum. If kept in a cool, dark place, it remains clear and is efficient for several months. After a year it begins to lose some of its power. Often before this time the serum becomes turbid and is

unfit for use. The strength of the serum is expressed in terms of an arbitrary unit, dependent upon its power to neutralize definite quantities of diphtheria toxins. Upon each bottle of antitoxin is indicated the number of antitoxin units which it contains.

Little is yet known of the nature or method of action of the antitoxin. According to one theory, its action is purely chemical, neutralizing the diphtheria toxins present in the blood; according to another, it acts by increasing the resisting power of the cells of the body to the diphtheria toxins.

With the object of investigating the local antidotal effect of antitoxin, doses of this were injected in certain cases with crude toxin. Three series of experiments made on guinea-pigs: (1) with toxin alone, (2) with toxin and a half-neutralizing dose (as regards its lethal activity) of antitoxin, and (3) with toxin and a fully-neutralizing dose (as regards its lethal activity) of antitoxin. Of the series treated with toxin alone, the earliest section to show undoubted cedema was the $5\frac{1}{2}$ -hour one. It was more marked in the 24-hour one. The fixed connective-tissue cells in all periods, from 1 to 24 hours, appeared swelled. At no period were there discernible signs of fragmentation of the nucleus nor of proliferation of the cells. The number of wandering cells seemed to vary directly with the length of the period up to 24 hours. In 1-hour and 2-hour sections the majority showed almost a uniform staining with hæmatoxylin. Fragmentation of nucleus was seen most markedly in 24-hour sections, though it was also seen, but to a less degree, in $10\frac{3}{4}$ -hour sections. In cells apparently endothelial in character the chromatin net-work stained faintly with hæmatoxylin, but was distinct. They were present in all sections, perhaps in greatest numbers in the latest ones. In most sections there were signs of cloudy swelling of the superficial muscular fibres. In the second series treated with toxin and a half-neutralizing dose of antitoxin it

was impossible to be sure of the reality of cedema before $5\frac{1}{2}$ hours after injection. This period was increased up to 24 hours. Connective-tissue fixed cells appeared swelled in twenty minutes' section, and this swelling was present in all sections. The changes in the wandering cells seemed to be similar to those in Series 1. The results of the third series treated with toxin and fully-neutralizing dose of antitoxin were practically the same as in the second series. The points elucidated by this research seem to be: (1) that the cellular changes are degenerative, and that there is no indication of proliferation of affected cells; and (2) that antitoxin, whatever may be its antagonistic effect generally, does not locally act as a chemical antidote to the toxin. J. J. Douglas (Brit. Med. Jour., Sept. 3, '98).

We have, as yet, no means of determining accurately the dose of antitoxin suitable to each case of diphtheria. It depends upon the severity of the case, the time of injection, and to a slight extent upon the age of the patient. We judge of the severity of the case by the location and extent of the membrane and the degree of constitutional depression. The tendency is constantly toward the use of larger doses of the antitoxin. In the early days of its use the antitoxin was comparatively weak and large quantities, as much as 20 cubic centimetres, were required for a single dose. Many of the unfavorable results at first reported were doubtless due to the large quantities of horse-serum which it was necessary to inject. It was also a difficult and painful procedure to introduce such quantities of fluid hypodermically. The antitoxin now used is many times stronger; so that even the largest doses rarely require more than 5 cubic centimetres. This concentration of the serum leaves us much more free in increasing the power of the first injection.

For children under two years of age,

severe cases, including all laryngeal cases, are usually given 1000 units, mild cases 600 to 700 units for the first dose. For children over two years, in severe cases, including all laryngeal, 1500 to 2000 units are employed, in mild cases 1000 units for the first dose. Some physicians employ stronger doses than these; as much as 3000 units may be given at a single injection. If no marked improvement follows the first injection, the dose may be repeated in from twelve to twenty-four hours. Third injections may be given, but are rarely necessary and are of little benefit, as the antitoxin has but little influence by that time.

In communities in which diphtheria is prevalent, 60 units sufficient to afford protection. Among 10,000 thus treated only 10 acquired diphtheria. To those who developed diphtheria after the 60 units and had a mild attack, nevertheless 150 units should be given. When infection is virulent, 600 units: a full curative dose. Several doses at intervals more serviceable than a single large dose. Behring (*Deutsche med. Woch.*, Nov. 15, '94).

Quantity required in a case varies from 1000 to 4000 units of Behring's standard, according to the weight of patient and severity of the disease. W. H. Park (*Med. Fortnightly*, Dec. 2, '95).

From $1\frac{1}{4}$ to $2\frac{1}{2}$ drachms are enough for benign cases taken at the onset; 4 to 6 drachms in severe cases or when they have passed several days; up to 1 ounce or even beyond in very severe cases. When breathing is embarrassed tracheotomy may be rendered unnecessary by an injection of 4 to 6 drachms, followed by another of from $2\frac{1}{2}$ to 4 drachms if improvement is not satisfactory. Better to inject at onset a dose of serum stronger than necessary, cutting short the malady rather than to inject weak doses at intervals. In infants under 1 year old as many as 15 minims may be injected as the child numbers months. In adults not necessary, unless case extremely grave, to inject more than 4 to 6 drachms the first

time. Roux (*Med. Press and Circular*, Mar. 20, '95).

That 600 units the most beneficial dose proved by the collective investigation of the *Deutsche medicinische Wochenschrift*, bearing upon 10,312 cases. Average percentage of 6 per cent. of deaths when 600 units used, average percentage of 14.6 when 1000 units used. (Annual, '96).

Observation on a series of cases of diphtheria that occurred in hospital, a wide-spread epidemic being imminent. In this outbreak none of the children was removed, but all that had been in any way exposed, 110 in number, were promptly immunized. The doses administered ranged from 250 to 500 units, according to age of child. Four or five of these children had sore throats with small patches on the following day. Each of these and all that had already developed the disease received 1000 units each. The result was a prompt recovery in every instance and no new cases have appeared in the institution since.

About same time 41 cases of diphtheria appeared in rapid succession in another institution. All were more or less complicated with measles and scarlet fever. Four initial cases did not receive the serum-treatment and all died. The remaining 37 cases received antitoxin treatment and but 2 died. Deducting the fatal cases, without a single exception, the 174 antitoxin-treated cases developed no sequelæ, either those receiving curative or immunizing doses. J. H. Lopez (*Med. News*, July 30, '98).

Children under eight years of age are given an initial dose of 500 immunizing units, to be repeated at intervals of six hours if the fever does not fall, if the strength of the patient does not improve, or if the local manifestations are spreading. To children over eight years of age, 1000 immunizing units are given as an initial dose, and repeated at intervals of eight to twelve hours if necessary. J. H. Musser (*Univ. Med. Mag.*, Mar., 1900).

For fifteen years before the diphtheria antitoxin was used the average number of deaths yearly was 2373; for the four years since the use of antitoxin the average was 1341. In mild cases, seen early, 1000 units are recommended; in

mild cases, seen late, 1000 to 2000 units; in severe cases, seen early, from 2000 to 4000 units; and in severe cases, seen late, an initial dose of not less than 3000 or 4000 units. W. H. Park (Phila. Med. Jour., Mar. 31, 1900).

A clinical study of 2093 cases shows that the recovery of the patient depends almost entirely on whether or not antitoxin is administered early enough and in sufficient quantity. The amount of diphtheritic membrane alone is an imperfect guide; it is often necessary to continue giving antitoxin after this has disappeared, for evidences of toxæmia sometimes outlast the false membrane. Clinical experience teaches that the effects of antitoxin are only salutary, and that there is no danger in giving too much. It also teaches that the sooner the total amount of antitoxin required can be given, the better. In the cases mentioned, therefore, 4000-unit doses were given and repeated every four hours as long as was necessary. In some exceptionally severe and late cases 4000 units were given every two hours, and in some cases 8000 units every four hours. Some patients thus received large quantities of antitoxin, and some moribund and apparently hopeless cases were saved from death. Indeed, some of the recoveries that have attended this mode of treatment were so wonderful that only those who saw them could appreciate them. F. G. Burrows (Amer. Jour. Med. Sci., Feb., 1901).

The injections of antitoxin may be made upon almost any part of the body, now that the quantity of serum used is comparatively small; the abdomen, thighs, or back may be preferred. An hypodermic syringe capable of holding 5 cubic centimetres is most convenient, but the ordinary hypodermic may be used in emergency. Some slight pain, redness, and œdema may be seen at the site of the injection, but nothing more, if proper care be taken in making the injection.

Reduction of post-injection accidents by heating the serum. In 1895-96, out

of 1365 patients treated with unheated serum, 208, or 15.2 per cent., suffered from post-injection accidents. In 1897, however, of 251 patients injected with the warmed serum, accidents were manifested in only 12, or in 4.7 per cent. The method of preparing the serum is as follows: It is collected under conditions of as perfect asepsis as possible, and without the addition of any antiseptic, and is put into small flasks of the capacity of ten cubic centimetres, closed with a cork and a capsule of caoutchouc. These flasks are kept for twenty minutes at a temperature of between 138° F. and 139° F. The heated serum is no way inferior to that not so treated. Spronck (Gaz. Hebdomadaire de Méd. et de Chir., Apr. 21, '98).

General eruptions may be seen in a large percentage of the cases in which antitoxin is used, if watch be kept for them. The eruption is in the form of an urticaria, as a rule, and develops about the tenth day after the injection. It may be transient and give no trouble or may continue for several days and be very annoying.

Temporary albuminuria has been repeatedly noted after immunizing doses of antitoxin, but this disturbance of the kidneys has always passed off without symptoms or sequelæ.

Swelling of the joints has also been reported in some cases, but must be very rare. These sequelæ of the use of antitoxin seem to be dependent upon the quantity of serum employed in the injection, and have certainly been much less frequent since the concentration of the antitoxin has allowed the use of smaller quantities of the serum.

The effects of the antitoxin upon the diphtheritic process may be almost immediate, and should be evident within twenty-four hours in all cases. Although it has no bactericidal power whatever, it affects both the local and the general condition. In the throat an advancing

process stops or at once begins its retrogression. The amount of discharge lessens, the swelling diminishes, the membrane ceases to spread, begins to soften, and becomes looser. The favorable influence is quite as marked in the larynx as upon other parts. The stenosis is relieved, as a rule, and the membrane is more rapidly thrown off. The general testimony is that, of the laryngeal cases, a much smaller proportion requires operative treatment for the relief of the stenosis since antitoxin has been used.

If intubation is resorted to, the tube is more often coughed out, or can be removed earlier than under any other form of treatment.

In 1892 the mortality of 5546 cases of intubation was 69.5 per cent.; 30.5 per cent. recoveries. In the cases treated with antitoxin and operated upon, the mortality was 27.24 per cent. The mortality of laryngeal diphtheria at present rests at 21.12 per cent.; 60 per cent. approximately have not required intubation; and the mortality of operated cases is at present 27.24 per cent. McNaughton and Maddren (*Med. News*, May 15, '97).

In Boston the mortality in the intubation-cases has fallen since 1895 from 83 per cent. to as low as 23 per cent. in those cases intubated this year. There have been 15 cases of diphtheria of the eye. In only one case there was destruction of the eye, and this organ was not in normal condition at the beginning of the attack; it is believed that there would have been a number of cases of blindness had it not been for the antitoxin. Large doses should be given early in the disease. J. H. McCollum (*Boston Med. and Surg. Jour.*, Aug., '98).

In the epidemic of diphtheria at Colchester during 1901 one of the most marked features was the fall in case-mortality at the isolation hospital after the routine use of antitoxin. Previous to July 16th antitoxin seems to have been employed only in the bad cases, and

the mean case-mortality during this period was 25.9 per cent., while during the same time the mean case-mortality among patients treated at home was only 10.8 per cent. From July 16th onward antitoxin was administered as a routine measure. There was immediately a remarkable diminution in the case-mortality, and for all the cases up to the end of December the mean case-mortality became 5.8 per cent. It is notable that the case-mortality among the cases treated at home during the same period not only did not diminish, but was rather higher than before,—viz.: a mean of 14.5 per cent. The diminution in the number of deaths, therefore, at the isolation hospital was not due to a diminution in the severity of the disease, but must be ascribed to the use of antitoxin; it was, moreover, abrupt, and coincided exactly with the administration of antitoxin.

Bacteriological examination of the throats of the school-children proved of considerable value in controlling the epidemic. All children coming from houses in which a case of diphtheria had occurred were examined, and were not admitted to the various schools until notified as being free from diphtheria bacilli. As regards the Hofmann bacillus, the opinion is expressed that it has no relation with the true diphtheria bacillus. Diphtheria bacilli were found to persist for a long period in the throat: in healthy children who had not been attacked up to ninety-four days; among those who had suffered from an attack up to eighty-seven days. Graham-Smith (*Jour. of Hygiene; Treatment*, May, 1902).

The constitutional effect of the injection is as marked as the local. Usually the temperature falls within twenty-four hours, the pulse improves, the mind is clearer, and the patient is evidently better in every way.

High temperature with corresponding rapidity of pulse, varying according to age and form of disease, fell following day and was normal third day when no

complications present. Distinct disparity between temperature and pulse frequently present. Disturbances of the circulatory system, among 154 cases, caused no deaths and did not in any noticeable way hinder recovery. Variot (*La Semaine Méd.*, Mar. 6, '95).

Rise of temperature always an important one; return to normal then very gradual, but temperature often remains very high; repetition of injection caused renewal of the effect produced. Kurt Müller (*Berliner klin. Woch.*, No. 37, '95).

Prompt fall of temperature accompanied by remarkably improved subjective sensations, typically altered course of fever. Heubner (*Weber die Erfolge der Heilserum-behandlung bei Diphtherie*, '95).

Temperature of 106.6° F. twenty hours after injection in a child and later on the disparity noted by Variot between temperature and pulse. Legendre (*Annual*, '96).

Rise in temperature after injection not only with antidiphtheritic serum, but also with artificial serum of Hayem and with the serum of non-immunized animals. Hutinel, Debove, and Sevestre (*Annual*, '96).

The cases apparently severe or fatal are transformed into mild ones. Baginsky tells us that, in recording the effects of antitoxin upon the various types of diphtheria, he found it necessary to require his assistants to write their judgment of the severity of the cases upon the admission card, when each case was first seen, since the antitoxin in most cases completely changed the picture.

The time of the injection has a most vital relation both to the immediate effect and to the ultimate outcome of the case. In experimental work an animal can usually be saved from a fatal dose of diphtheria toxin, if antitoxin is given within forty-eight hours, but not later. Clinically good results can usually be had if antitoxin is given within three days of the onset of the diphtheria, but later

than that its influence is greatly lessened. In the "Antitoxin Report of the American Pediatric Society" the mortality of first-day injections was 4.7 per cent.; of second day, 7.4 per cent.; of third day, 8.8 per cent.; of fourth day, 20.7 per cent., and of fifth day, 35.3 per cent.

Report of the American Pediatric Society's collective investigation into the use of antitoxin in the treatment of diphtheria in private practice.

Result as influenced by the time of injection: 5794 cases with 713 deaths,—a mortality of 12.3 per cent., including every case returned; excluding 218 cases moribund at the time of injection, or dying within twenty-four hours of the first injection, the mortality was only 8.8 per cent.

Of the 4120 cases injected during the first three days there were 303 deaths,—a mortality of 7.3 per cent., including every case returned. If, again, the moribund cases are excluded, there were 4013 cases with a mortality of 4.8 per cent. After three days the mortality rises rapidly, and does not materially differ from ordinary diphtheria statistics.

Results as modified by age of the patients: The highest mortality is found to be under two years; but including all cases returned, even those moribund when injected, the death-rate was but 23.3 per cent. After the second year there is a steady decline in mortality up to adult life. Of 359 cases over 15 years old, there were but 15 deaths.

Paralysis: Out of 3384 cases paralytic sequelæ appeared in 328 cases (9.7 per cent.). Of the 2934 cases which recovered, paralysis was present in 276, or 9.4 per cent. Of the 450 cases which died, paralysis was noted in 52, or 11.4 per cent.

Sepsis: This is stated to have been present in 362 out of 3384 cases, or 10.7 per cent. It was present in 145, or 33 per cent., of the fatal cases.

Nephritis: Nephritis was present 350 times, or in 10 per cent. of the cases. The statements on this point are not quite satisfactory.

Whole number of cases of laryngeal diphtheria, 1704; mortality, 21.12 per cent. (360 deaths).

The cases occurred in the practice of 422 physicians in the United States and Canada.

Operations employed:—

(a) Intubation in 637 cases; mortality, 26.05 per cent. (166 deaths).

(b) Tracheotomy in 20 cases; mortality, 45 per cent. (9 deaths).

(c) Intubation and tracheotomy in 11 cases; mortality, 63.63 per cent. (7 deaths).

Number of States represented, twenty-one, the District of Columbia, and Canada.

Non-operated cases, 1036,—60.79 per cent. of all cases; mortality, 17.18 per cent. (178 deaths). (*Archives of Pediatrics*, July, '96.)

In Japan, prior to serum-therapy, the mortality was 56 per cent.; after its use in 353 cases the mortality was 8.78 per cent. Of 110 cases in which injections made within forty-eight hours after invasion, all ended in recovery. Of 33 cases treated after eighth day of the disease 11 were lost. Kitasato (*"Serum Treat. of Diph."* '96).

In 600 cases of diphtheria treated, one-half were given antitoxin, the other half had no antitoxin. The Klebs-Loeffler bacillus was found in all cases. The cases were treated in the same hospital, had exactly the same food, drugs, and stimulants.

In the 300 cases treated with antitoxin there were 129 tracheotomies; 60 died, the death-rate being 20 per cent.

In the 300 cases treated without antitoxin there were 199 tracheotomies and 158 deaths,—a death-rate of 52.7 per cent. The earlier the serum is used, the better the results; however, it is of value even when given late. In 20 per cent. of laryngeal cases, even when there is dyspnoea, it lessens the necessity for operation. Clubbe (*Brit. Med. Jour.*, vol. xi, p. 1177, '97).

Laryngeal diphtheria, in any epidemic, is never mild, but has always had a mortality of from 90 to 95 per cent., reduced by operation, intubation, or tracheotomy, to from 72 to 76 per cent. In-

tubation without serum shows a mortality of 76 per cent.; in conjunction with a serum of 25 per cent., and, eliminating cases of death within twenty-four hours of injection, a mortality of 10 per cent. The reduction of mortality from 76 to 10 per cent. is to be credited to antitoxin. Antitoxin should always be administered as early as possible, and in laryngeal cases without waiting for the bacteriologist's report. No child should be allowed to die of laryngeal stenosis without an operation, preferably intubation, and serum should be injected at once, regardless of the stage of the disease, as most desperate cases often end in recovery. Halsted (*N. Y. Med. Jour.*, vol. lxx, '97).

Statistics from the Imperial Board of Health in Berlin: The reports, gathered from April, 1895, to March, 1896, were furnished by 258 physicians from 204 institutions. Of 9851 cases of diphtheria treated with antitoxin, 1489 proved fatal, or 15½ per cent. After deducting the absolutely hopeless cases, which perished within the first twelve hours after they were seen, the mortality is reduced to 14⅞ per cent. Adding to these 9851 cases the result of a former report (January to April, 1885) and 1328 cases from March to July, 1896, published later, a total of 13,137 cases, divided over eighteen months, furnished a mortality of 2082, or 15⅘ per cent. Of these, 4085 patients, or 42.6 per cent., presented the laryngeal variety, 2744 of which were operated upon, with a mortality of 32⅘ per cent. The mortality of cases treated on the first day was 6.6 per cent.; that of those treated on the second day, 8.3 per cent.; of those treated on the third day, 12.9 per cent.; of those treated on the fourth day, 17 per cent.; and of those treated on the fifth day, 23.2 per cent. Dieudonné (*Internat. Med. Mag.*, Dec., '97).

During the year 1896 there were examined at the laboratories 7832 cases that had been certified "diphtheria." Of these cases, 5068 had diphtheria bacilli in the throat and 1362 suffered from paralysis of a more or less marked kind. Of these cases, 1096 had been treated with antitoxin, and there were 273

deaths among them; 266 received no antitoxin (that is, they were most of them mild cases in all probability), and there were 49 deaths. In 1764 of the cases examined in which no diphtheria bacilli were found, there were 177 cases of paralysis with 59 deaths; 89 of these cases were treated with antitoxin—31 deaths. There were, moreover, 88 not treated with antitoxin, 28 of these succumbing. G. Sims Woodhead (*Brit. Med. Jour.*, Sept. 3, '98).

Coupling the danger of delay with the harmless nature of the antitoxin, it is quite plain that antitoxin should be given in every case where the diagnosis of diphtheria is probable. Only in mild cases may we wait for the bacteriological diagnosis. Especially in all laryngeal cases should the immediate use of antitoxin be advised.

No harm is done if the case is not diphtheria, and, if it is, a great advantage is gained.

We may safely assume that the use of antitoxin is harmless, for if all the reported cases of sudden death or aggravation of cardiac or renal disease or other unfavorable influence were accepted as proved, they could not, for a moment, be weighed against the accumulated evidence of the curative effect of antitoxin in diphtheria.

Effect on the kidneys of small preventive doses (2 to 3 centimetres) of diphtheria antitoxin studied in 73 cases, and shows no deleterious influence. No traces of albumin were discovered in the urine. Also report of a case of severe scarlet fever and nephritis in which diphtheria supervened, and larger doses of the antitoxin (10 centimetres) were administered. The diphtheria was arrested at once, and the nephritis also seemed to be favorably affected and retrogressed, although more slowly. Rojanski (*Botkine's Gazette*, No. 36, '96).

Since the introduction of the antitoxin treatment the incidence of paralysis following diphtheria has certainly increased. The reason of this is believed

to be that patients now recover, or, at any rate, live long enough to show symptoms of paralysis, who without antitoxin would have died at an earlier period. Though the number of cases of paralysis, relatively as well as absolutely, has increased, the number of fatal cases has diminished. If the serum-treatment were commenced early enough, the number of cases of paralysis would be lower instead of higher than before. E. W. Goodall (*Brit. Med. Jour.*, Sept. 3, '98).

Antitoxin has been given in large doses in guinea-pigs and rabbits, but a case has never been seen in which by itself it had produced any paralytic symptoms. The heart fails earliest and most frequently because it is the organ which really gets least rest. This condition of overwork and ill nutrition is the great factor even in those paralyzes that appear later. The poison does its work, but it is only when muscle and nerve are called into functional activity that the damage is unmasked and the tissues give way under a strain which in health they would readily stand.

Cases of paralysis are now not so frequent as formerly; and those which do occur are less severe. The antitoxin should be used before degenerative changes have been set up, and enough antitoxin should be given to neutralize not only the lethal action of the diphtheria toxin, but also its local and paralysis-producing action. Sims Woodhead (*Brit. Med. Jour.*, Sept. 3, '98).

Influence of antitoxin on diphtheritic paralysis summarized as follows: Up to the present the percentage of paralysis has increased, on the whole. There is some evidence that large doses—*i.e.*, not less than 4000 units—of antitoxin are more effective than small ones, both in preventing paralysis and diminishing the mortality due to it. The earlier antitoxin is given in diphtheria, the less likely is paralysis to follow. Should it occur after early injection, it will probably be mild and of comparatively short duration. The type of paralysis has become less dangerous to life. Finally, diphtheritic paralysis has become more prone to attack the young. The full value of antitoxin is only obtained by

using it early and in efficient doses. Woollacott (Lancet, Aug. 26, '99).

Conclusions regarding action of diphtheria toxin on the nervous system are: the essential lesion is parenchymatous degeneration of the peripheral nerves, the slight changes in the anterior-horn cells are held to be secondary or of cachectic origin, while the vascular alterations play but a subordinate rôle in the pathogeny of post-diphtherial palsy. Bielschowsky and Nartowski (Neurol. Centralb., July 1, 1900).

That evidence has been so fully presented in the articles by Welch, Biggs and Guerard, and the Report of the American Pediatric Society, already referred to, and is so complete, that no attempt is made to introduce it here.

There are certain definite limitations of the efficiency of the diphtheria antitoxin. It has already been pointed out that not all the lesions of diphtheria are produced by the action of the diphtheria bacillus or its toxins.

Certain of them, especially the broncho-pneumonia and nephritis, are believed to be due to the action of streptococci.

Diphtheria associated with streptococci is the gravest form met with; in children it is the most frequent determining factor of broncho-pneumonia. E. Roux (Universal Med. Journal, p. 289, '94).

In the severe and most highly infectious forms of diphtheria accompanied by marked hyperæmia and swelling of the faucial and adjacent surfaces, streptococci occur not only in the superficial, inflamed parts, but in the deeper, contiguous tissues, as the submaxillary and perilaryngeal glands and the adjacent connective tissue. In some cases these adventitious germs, by penetrating deeply, cause not only a cellulitis which may end in suppuration, but set up a broncho-pneumonia. H. Barbier (Gaz. Méd. de Paris, Sept. 30, '94).

Organisms present in 32 fatal cases: Loeffler's bacillus only, 37.5 per cent.; with streptococci, 25.0; with staphylococci, 18.7; with streptococci and staphy-

lococci, 18.7. In all cases staphylococci pyogenes aurei found. No fatal results took place when only cocci were present. Shuttleworth (Lancet, Sept. 14, '95).

By mixing cultures of the streptococcus with those of the Klebs-Loeffler bacillus, a considerable increase in the virulence of the latter is observed. The dose necessary to kill a guinea-pig was much less than that required for a culture of the diphtheria germ. If the dose was decreased to the point of permitting life for two or three weeks, there was observed, besides emaciation, a diminution of the secretion of urine, which became sanguinolent. The autopsy showed especially profound alterations in the kidneys, visible to the naked eye. The glomerules were swelled, and projected above the cut surface. The microscope showed the shedding of epithelium from the urinary tubules and the presence in their lumen of numerous altered red globules. These lesions cannot be obtained with pure cultures of the streptococcus, but only by adding to the diphtheria cultures the toxins of streptococci obtained from cultures four weeks old. Bonhoff (Hygienische Rundschau, No. 3, S. 97, '96).

In cases of mixed infection the symptoms of ptomaine poisoning due to the Klebs-Loeffler bacillus may be preceded by those due to staphylococci and streptococci, which latter may even subsist before the onset of the graver symptoms. If the Klebs-Loeffler bacillus is the "principal invading germ," then "antitoxin will bring the crisis of the disease within twenty-four hours. If it is the streptococcus, there will be a long, hard fight." Streptococcic angina is marked by pain, and is not benefited by antitoxin. Jaques (Lancet, Jan. 15, '98).

Upon these processes the antitoxin can have no direct effect. By lessening the depression produced by the diphtheria, antitoxin may enable the patient to resist the further attack of the streptococci or other pathogenic organisms; it cannot be expected to do more. It has also been urged against the antitoxin that diphtheritic paralysis is quite as fre-

quent after its use as it was without antitoxin.

To this two reasonable replies have been made: One, that the nervous system is most susceptible to the action of the diphtheria toxins and therefore most difficult to protect; so that, while antitoxin can save the life of the patient, it cannot protect him from the particular effect of his disease. The other is the ingenious suggestion that by saving the lives of many who, suffering from severe diphtheritic infection, would, in all probability, have died under any previous form of treatment, antitoxin increases the number of those in whom we should reasonably expect to see diphtheritic paralysis develop.

In order to determine the relation between forms of the Klebs-Loeffler bacillus and the severity of the disease, twenty-seven cases studied. The following conclusions submitted: 1. The short Klebs-Loeffler apparently produces a toxin of greater virulence than the longer forms, although local manifestations may not be so extensive. 2. The long Klebs-Loeffler bacillus and the streptococci when found alone (together) give rise to a mild type of the disease. 3. The streptococcus is found associated with the short bacillus in the most severe cases; possibly by causing a more intense inflammatory reaction it opens avenues by which the toxins of both are more readily absorbed. 4. The beneficial action of antitoxin in cases in which the Klebs-Loeffler bacillus is not present may be due to the fact that, although the local effect of different microbes varies, there are many features of similarity in the constitutional symptoms produced by them. W. J. Class (*Jour. Amer. Med. Assoc.*, Apr. 30, '98).

The streptococcus and the diphtheria bacillus enhance each other's virulence, and diphtheria antitoxin has no effect after septicæmia has developed. Hence the necessity of beginning antitoxin treatment at the first indication of diphtheria infection, before the streptococcus

has had time to get in its work and increase the virulence of the diphtheria bacillus and to be reciprocally affected. P. Hilbert (*Deut. med. Woch.*, Apr. 14, '98).

The method of administration of the antitoxin and its mode of action are such that it in no way interferes with the use of any other form of treatment that may be regarded beneficial. Being given hypodermically, it does not disturb the stomach or interfere with feeding or medication. Fish, of St. Louis, has recently reported experiments going to prove that antitoxin given by mouth is effective. Similar experiments made by Park gave negative results. It is doubtful whether any advantage would be gained if it were possible to introduce the antitoxin in this way.

Antidiphtheria serum given by the mouth has proved eminently satisfactory in nine cases. The effect was quite as good as if the serum had been given hypodermically, and no evil results followed,—no gastric disturbance, no skin eruption, and no joint or renal affection. Before deciding as to the dose required, however, further experience is desirable. In the first five cases the dose given was the same as would have been given hypodermically. De Minicis (*Gaz. degli Osped.*, July 19, '96).

For curative purposes the administration by the mouth should be restricted to exceptional cases; but for prophylactic purposes this method should receive the preference. J. Zahorsky (*N. Y. Med. Jour.*, Mar. 19, '98).

Laryngeal stenosis may call for further treatment. The general testimony is that antitoxin exerts a marked, in some cases a marvelous, influence upon diphtheritic stenosis. It is also agreed that since the general use of antitoxin a greater percentage of laryngeal cases have escaped operative interference than were before, and of those finally operated upon a greater number had recovered.

The triumph of antitoxin has been that of intubation as well. (See INTUBATION.)

Tracheotomy has practically passed out of use in diphtheritic stenosis of the larynx.

Many forms of treatment were formerly combined with the use of antitoxin, but, as the power of the antitoxin has been more fully demonstrated, the tendency to rely upon it has become stronger. At the present time, apart from the general treatment—diet, rest, etc.—after giving antitoxin we confine our efforts to the careful cleansing of the nose and throat and the use of stimulants.

Advantages of intubation in diphtheria. It is rapid and requires no anæsthetic; there is no operation; the respiration takes place through the natural openings. In these days of antitoxin, if there is skilled assistance to rely on during the absence of the operator, it has enormous advantages over tracheotomy, but these quickly disappear when skilled assistance is absent, and it must not be forgotten that tracheotomy-tubes can now be removed after a much shorter period than formerly. Hughes (*Scottish Med. and Surg. Jour.*, June, '97).

There is still some doubt as to the method of taking out the tube after intubation. There are disadvantages attending the thread method, and especially because the fixing of the tubes thus produced does not allow of its free play, and hence causes erosion of the parts. The extractor, on the other hand, is hardly possible in private practice, as a sudden stoppage of the tube by membrane may cause suffocation unless the tube can be withdrawn without delay; it also requires considerable skill, especially where a small tube sinks deeply into the larynx. Where attempts at extraction cause a small tube to sink farther down, pressure with the thumb on the trachea, just below the cricoid cartilage, where the end of the tube can be felt; the cough thus produced forces the tube out. This method of expression

never fails. The pressure may be made with both thumbs, the finger finding support on the neck; it should be directed inward and directly upward. If more powerful pressure is exerted, the tube may be forced, not only into the mouth, but even completely out of it. No disadvantages attend this method. Trumpp (*Münch. med. Woch.*, Jan., '98).

Conclusions based on treatment of 100 cases of laryngeal diphtheria with antitoxin in conjunction with intubation: Antitoxin should be administered early, without waiting for a bacteriological diagnosis. Tonsillar exudate attended by a croupy cough or partial aphonia is an indication for a full dose of 1500 to 2000 units of antitoxin. Antitoxin administered twelve hours or more prior to operative interference will reduce the mortality of intubated cases at least 50 per cent. Early operation urged. Results are summarized as follows: Number of operations, 100; recoveries, 69; deaths, 31; mortality under 3 years, 49 per cent.; mortality over 3 years, 19 per cent.; complicating measles, 8 cases, 5 deaths. Shurly (*Jour. Amer. Med. Assoc.*, May 19, 1900).

Intubation has become more common since the introduction of antitoxin, for cases are less severe and tracheotomy does not so often become necessary. Primary tracheotomy is indicated in children under 1½ years with outspoken rickets, serious collapse, widespread pharyngeal ulceration, severe dyspnoea and œdema of the larynx, spasmodic or mechanical obstruction in the larynx, large œdematous swellings (such as subcutaneous emphysema of the neck), bronchial stenosis, or continued dyspnoea after intubation. Secondary tracheotomy is indicated when the tube has been in several days and dyspnoea continues after the fourth intubation, when membranes close the tube, when laryngeal abscess occurs, when the thymus or bronchial glands are enlarged, when frequently changing the tube gives no relief, when the child cannot swallow sufficient food, and when dyspnoea follows intubation twice, five or six days after intubation, in children under 2 years. Intubation should be performed

early, all indications for tracheotomy must be overcome, everything must be prepared for a possible tracheotomy, patients must be kept in a well-steamed atmosphere, the smallest tube should be introduced but once, bromides should be given before extubation, and all should be ready for a new intubation when extubation is done. In children under 2 years the tube is left in on an average of 2 to 4 days; from 2 to 4 years, 3 to 6 days; over 5 years, 3 to 4 days. Intubation may be done experimentally, preliminary to tracheotomy or during tracheotomy, and before or after closing the tracheotomy wound. In private practice intubation is only justified when the physician has had experience, antitoxin has been given, and a good nurse secured. It is only indicated, then, when no bronchial stenosis exists, the larynx is not swollen or ulcerated, and no indications for tracheotomy are noted. The tube is left in as long as no indication for secondary tracheotomy appears and the child bears it well. Rahn (*Jahrbuch f. Kinderh.*, Feb., 1902).

The results of intubation after the administration of antitoxin have been most brilliant. Whereas two-thirds of such cases died before the use of antitoxin, with it about two-thirds recover. The indications and technique of the operation are described in the article on INTUBATION.

Tracheotomy should be resorted to only when no trained intubator can be had or intubation has been tried and has failed. The Continental practice of resorting to a secondary tracheotomy if a tube has been worn four days rests upon no rational basis and should be abandoned. By using hard-rubber tubes, the perfection of which was one of O'Dwyer's last labors, we may leave the tubes in the larynx for months without danger of harm.

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DISLOCATIONS.

Definition.—A dislocation is a permanent, abnormal, total, or partial displacement from each other of the articular portions of the bones entering into the formation of a joint.

A sprain is a temporary, partial displacement, reduced immediately and spontaneously.

In total, or complete, dislocations the articular surfaces are completely separated, or touch each other only at their edges. In ball-and-socket joints the dislocation is said to be complete when the centre of the globular head is displaced beyond the rim of the concave socket.

Lesser forms of displacement are termed partial, or incomplete, luxations, or subluxations.

A diastasis is a subluxation in which the separation occurs in a plane perpendicular to that of the articular surfaces, without lateral gliding of one upon the other. The most frequent examples of this condition are the so-called "subluxation" of the head of the radius in children, and the tibio-fibular diastasis in Pott's fracture.

A dislocation is complicated by injuries to surrounding tissues of sufficient importance to affect materially the symptoms, prognosis, diagnosis, or treatment. It is rendered compound if the laceration of the soft parts establishes a communication between the cavity of the joint and the outside air.

Symmetrical dislocations on both sides of the body (*viz.*, both shoulders, both hips) are termed double. If they occur in the one bone (jaw, vertebræ), they are called bilateral.

Varieties.—Dislocations are classified, according to their etiology, as traumatic

and spontaneous. *Traumatic* dislocations are caused, not only by external violence, but also by muscular force. Such, for example, as the forward dislocation of the mandible. *Spontaneous* dislocations are due to pathological processes in or about the joint which so weaken its normal supporting structure that luxation occurs gradually (or suddenly) and without recognizable trauma. Occurring in extra-uterine life these dislocations are termed *pathological*, while, if their origin is prenatal, they are *congenital*.

Nomenclature.—Usually the distal member of a joint is said to be dislocated,—the most notable exception is the so-called dislocation of the outer end of the clavicle (acromio-clavicular joint); and the direction of the dislocation is that taken by the dislocated bone: thus a backward dislocation of the humerus means that the head of the humerus has been dislocated backward from the glenoid cavity, and lies behind it (unless it has been shifted by a secondary or consecutive displacement). Sometimes, however, we speak of a dislocation as of the joint itself, dislocation of the elbow, of the knee; here, again, the direction of the dislocation being that taken by the distal segment. Thus, instead of saying a “backward dislocation of the humerus,” we might say “a backward dislocation of the shoulder.” Subvarieties are named, according to the new anatomical position of the distal segment, as subcoracoid, dislocation of the humerus, iliac (or dorsal) dislocation of the thigh.

Finally, it is well to bear in mind the distinction between “typical” and “atypical” dislocations, typical dislocations being those in which the attitude of the limb is characteristic, and atypical those in which, owing to the laceration of some opposing structure, whose integrity is usually preserved, the characteristic po-

sition is not present. An “atypical” backward dislocation of the hips is the so-called “everted dorsal,” in which, owing to the rupture of the outer branch of the Y-ligament, the thigh is everted instead of assuming the usual attitude of inversion and adduction.

Symptoms.—Deformity is always present. The displacement of the articular surface changes the normal contour: a change which can be accurately verified by ascertaining by palpation the abnormal position of the various bony prominences; moreover, the new position of the head of the bone makes a new and abnormal centre for the movements of



Fig. 1.—Diagram to show the action of a ligament in limiting the range of motion in a dislocation. (Stimson, “Dislocations.”)

the joint, and, in connection with the restricting influence of untorn ligaments or bony prominences, gives rise to a more or less characteristic attitude and restriction of motion in certain directions.

The comprehension of the causes which produce this constrained attitude and restricted motion, while of great assistance in diagnosis, is, in many cases, absolutely essential to intelligent manipulative treatment, for those same forces that aid our diagnosis we must take into account in our efforts to effect reduction. These forces are purely mechanical. The dislocated bone plays the part of a lever whose long arm extends from the attachment of certain ligaments to its distal

extremity and whose short arm is that part of the bone between this point of attachment and the head of the bone.

The figure shows how the ligaments opposite the side toward which the bone has been displaced are put on the stretch by attempts to move the lower part of the limb in the same direction, so long as the head of the bone impinges upon the outer edge of the articular surface or some similar obstacle. Hence the abnormal attitude and restriction of motion in some directions—and possibly abnormal mobility in others, be it noted—and hence, also, the inference that such an

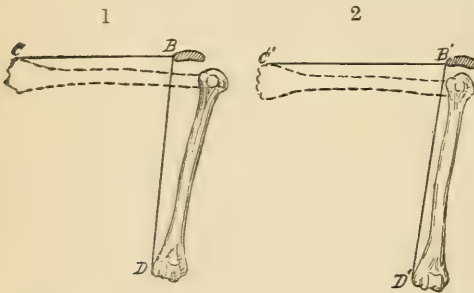


Fig. 2.—Diagram to show the effect of attitude upon the measured length of the arm (1) in dislocation of the right shoulder and (2) when the bones are in a normal position; B, B', the acromion. (*American Text-book of Surgery.*)

obstacle is not to be overcome by brute force, but rather by strategy and dexterity.

Shortening or lessening of a limb is another aspect of the deformity. As a sign, however, it is most unreliable. Fig. 2 indicates the relative positions of the bones in a subcoracoid dislocation of the shoulder as compared with the normal joint. With the arm abducted, the shortening is marked, but in adduction there is little or no shortening; indeed, there may be some lengthening.

Crepitation of a fibrous quality may be elicited during manipulation by friction

of the bone over fibrous or cartilaginous structures, and means nothing. True bony crepitus means, of course, a fracture.

Pain is always present, and is due to two causes. There is the primary pain caused by the laceration of the tissues at the moment of the dislocation. This soon passes away. Any persistent pain is due to pressure on nerves, and can only be relieved by the removal of that pressure.

Loss of Function.—This is usually complete, and due partly to the pain and partly to the fixation caused by the changed relations of the bones.

Symptoms of Old Unreduced Dislocations.—Deformity of contour and attitude, as well as restriction of motion, will persist as long as the dislocation remains unreduced; but, as the parts tend to adapt themselves to their altered conditions, the disability becomes progressively less, as a general rule, until the functions of the limb can be fairly well performed. But several conditions may interfere with this restoration of function. An excessive production of callus may limit the motions of the joint or even ankylose it in an awkward position; the head of the bone may be progressively displaced farther from its normal situation, and the disability thus become greater instead of less; or an intractable neuralgia or oedema may result from pressure on adjoining nerves or vessels.

Diagnosis.—The one demonstrative sign of dislocation is the recognized presence of the head of the dislocated bone in an abnormal position. One may make the same inference from the negative evidence; namely, the absence of the head of the bone from its normal situation. Thus, in backward dislocation of the ribs or the sternum the diagnosis is made by the absence of the heads of the bones

from where they should be, and not by their presence where they should not be.

In such localities as the fingers or knee the head of the bone may be seen; elsewhere it may be felt, as in the jaw (forward) or the shoulder; or, again, the diagnosis may only be ascertained by finding an indefinite mass which partakes of the motions imparted to the bone. Measurements may help; but, as above noted, are liable to be fallacious.

In typical dislocations the attitude of the limb and the limitation of motion are usually the first hint the surgeon obtains of the nature of the case; but, we repeat, the only conclusive evidence is the discovery of the head of the bone out of its normal place.

DIFFERENTIAL DIAGNOSIS.—The differentiation of a simple dislocation from a fracture at or near the articular surfaces is often difficult, sometimes impossible. If the fracture is through the neck of the bone (without impaction) the dislocated head will not move with motions imparted to the shaft of the bone; but will, on the contrary, give rise to a bony crepitus, unless some soft parts are interposed. But if the fracture consists simply of the splintering of an articular edge, or the tearing off of a tuberosity, the fragment may be pushed or drawn away and give no evidence, except perhaps a weakness in the joint, a lack of certain motions, or a tendency to recurrence of the dislocation, for which we can only assign the fracture as a probable cause.

The statement that mobility is increased in fracture and decreased in dislocations is misleading and inaccurate. In fractures mobility is not increased, but created where before it was not. In dislocations it is decreased in some directions, but it is not infrequently increased in others; and, indeed, with sufficient

laceration of all the soft parts it may be increased in all directions. A dislocation may be readily differentiated from a contusion or sprain by examination under ether.

Etiology. — **PREDISPOSING CAUSES.**—Normal predisposing causes exist to a greater or less degree in all joints; otherwise no joint not diseased could be dislocated: a theory long since rejected. These causes mainly exist in the conformation of the bony surfaces which make up or surround the joint. In some positions there is little resistance to a dislocating force properly applied. Thus, the wide-open jaw may be dislocated forward by a relatively-small force, there being but the slightest resistance of bone and ligament to overcome. Or, again, the normal angle at the joint, as at the elbow, predisposes to dislocation by applying a transmitted force (from the hand) in a direction oblique (upward and inward) to the long axis of the joint, and thus tends to force the articular surfaces over each other in an abnormal direction. Moreover, certain outlying prominences may aid dislocation by acting as fulcra to pry out the head of the bone, as does the olecranon in hyperextension of the elbow and the acromion in hyperextension of the shoulder. Some joints are also more frequently exposed to external violence than others. Pathological predisposing causes are fracture or disease of the bones, disease of the ligaments or atrophy of muscles that act as ligaments, and distension of the joint with fluid.

IMMEDIATE OR DETERMINING CAUSES.—External violence may cause dislocation directly by acting upon the articulation itself, as a dislocation of the humerus by a blow upon the shoulder, or indirectly by force transmitted through the shaft of the bone, as in the same dislo-

cation caused by a fall upon the outstretched hand, or more complexly by leverage, as when a fall upon the shoulder dislocated the inner end of the clavicle upward by leverage exerted on the first rib as a fulcrum.

Muscular action may also be exerted either directly or indirectly. Thus, yawning is a common cause for dislocation of the lower jaw. In fact, certain persons can voluntarily dislocate one or other of their joints. The most common example is the backward subluxation of the first phalanx of the thumb; but there are also a few subjects who can throw out their larger joints, as, for example, a man who is at present traveling about exhibiting his power of dislocating both hips and both shoulders.

Pathology of Recent Dislocations.—

In joints relaxed by paralysis or effusion (and in the jaw) dislocation habitually takes place without laceration of the capsule. In all other cases (excepting the voluntary dislocations before mentioned) the capsule is torn. In enarthrodial joints the rent is on the side toward which the round head of the distal bone is displaced. In other joints any or all of the ligaments may be torn. The firmer bands, instead of giving way themselves, may strip up the periosteum or tear away the bony prominences to which they are attached. Opposing muscles put upon the stretch may act in the same way. The bones may also be broken by impact on each other; thus fracture of the olecranon occurs in anterior dislocation of the elbow, and a mutual bruising of the head of the humerus and shattering of the rim of the glenoid cavity in dislocations of the shoulder.

Complications.—Fractures worthy of the name of complications may occur. Some, indeed, such as fracture of the anatomical neck of the humerus, may

prove insurmountable obstacles to reduction. External wounds, especially if they compound the dislocation, may prove serious complications. Adjoining vessels may be ruptured and give rise to fatal hæmorrhage or to occlusion and gangrene, or to traumatic aneurisms. The rupture of nerves, of which the most common is circumflex at the shoulder, may cause permanent paralysis and anæsthesia. The viscera are rarely injured unless by some other associated trauma.

In old unreduced dislocations the lacerated connective tissue about the head of the bone becomes thickened and forms a pseudocapsule, while the periosteum on which the head of the bone now rests is stimulated and throws out a ridge of bone so as to form a new articular cavity, sometimes lined with fibrocartilage. The muscles and ligaments shrink or elongate to adapt themselves to their changed circumstances, and thus a comparatively useful new joint may be formed. In the meanwhile an opposite train of events takes place in the old joint-cavity. It is obliterated either by adhesion of the capsule or by filling up with granulation-tissue. Thus not only is the dislocated bone fixed in its new position, but also the old socket is obliterated and rendered unfit for its reception. It is important to note that the scar may include neighboring vessels or nerves and by pressing on them give rise to neuralgia or œdema without any direct pressure by the bone itself, and, moreover, the tearing of this tissue in attempts at reduction may result in fatal injuries to vessel or nerve.

Prognosis.—Reduction is usually followed by repair of the damage done, and within a few weeks the joint is as useful as ever. Occasionally, however, a permanent laxity of the capsule remains, which allows the dislocation to recur on more or less slight provocation, and with each

recurrence the tendency grows more marked. Occasionally, also, without any unusual evidence of injury to the nerves at the time of occurrence of the accident, a dislocation may be the starting-point of an intractable neuralgia, or it may predispose the joint to rheumatism. The complications above mentioned render the prognosis more grave.

In old unreduced dislocations the prognosis is different for every individual case. In some the new joint will become fairly useful, in others not so; yet the prospect of relief by operation is none of the brightest.

Treatment.—A recent dislocation should be immediately reduced unless great inflammatory reaction, swelling, or shock render the infliction of pain or the use of anæsthetics inadvisable.

Anæsthetics are of use to overcome the resistance of the muscles which, contracted by pain or fear of pain, oppose the manipulations necessary for reduction, or in case the patient cannot or will not suffer the pain incident to those manipulations. Reduction may usually be effected in "primary" anæsthesia. Ether is safer than chloroform for this purpose.

The choice of the method of reduction depends upon the recognition of the obstacles to reduction. Aside from muscular opposition, the usual obstacle is the resistance offered by untorn ligaments or portions of the capsule to motion in certain directions. Other obstacles are interposition of the ligaments or muscles, and these may be of such a nature as to demand operative interference.

The older methods of reduction by means of direct pressure on the head of the bone or traction by hand, by pulleys, or by electric force have been, in great measure, superseded by the more scientific and practical method of reduction by manipulation, in which, by a succes-

sion of gentle movements, the head of the bone is brought opposite the tear in the capsule, the opening is enlarged by relaxation of its sides, and the head of the bone slipped into place by leverage on the untorn portions of the capsule and ligaments, aided, if need be, by traction and pressure on the bone.

In old dislocations the manipulations useful in recent cases are much less likely to succeed, owing to the firm adhesions binding the head of the bone in its new situation and the obliteration of the disused articular cavity. Moreover, strong traction may be required to overcome the contraction of the muscles. Interference in such cases is unavoidably blind and uncertain, and involves much more extensive laceration than took place at the time of the original injury. So many accidents have followed attempted reduction by manipulation in these cases that, if cautious manipulation fails to effect reduction, it is better to leave the dislocation unreduced in the majority of cases; or, if the loss of function is so great as to induce the surgeon to run the risk, an open arthrotomy may be done with the hope of dividing the opposing structures, opening up the old socket, and replacing the dislocated bone.

The accidents which follow ill-advised attempts at reduction are usually fracture of the bone or rupture of vessels, leading to hæmorrhage, gangrene, or aneurism. More rarely injury to large nerves has occurred, and even complete avulsion of a limb has been recorded.

After-treatment.—After reduction the joint need usually be kept immobilized only a few days, and excessive motions avoided for a few weeks. Some dislocations require special dressings (*e.g.*, clavicle). Gentle passive motion should usually be begun within at least three weeks to prevent adhesions.

Habitual dislocations have been cured at the inner end of the clavicle by peri-articular injections of alcohol (Stimson) and at the shoulder by injections of tincture of iodine. But this method of producing adhesions offers so grave risks of ankylosing the joint that in the more important joints it is advisable, if the tendency cannot be overcome by the prolonged wearing of an immobilizing apparatus, or one which allows only slight motion, to excise, or take a "reef" in, the lax portion of the capsule.

Congenital Dislocations.—Under this head are included all dislocations supposed to have existed at birth—although sometimes not diagnosed for months or years—and to have been caused by a mal-development of the joint, hydrarthrosis, paralysis, etc. Dislocations produced traumatically *in utero* or during delivery are excluded.

Congenital dislocations of the hip cover about 90 per cent. of all cases. They are more usual in females than in males. One or both joints may be involved. The typical cases are caused by a defective development of the Y-cartilage and acetabulum, which permits the influence of the weight of the body, or the contraction of the muscles, to drag the head of the bone out of the socket on to the dorsum of the ilium.

Pubic and obturator dislocations are very rare. As the child begins to walk the head is pushed farther upward until it is finally arrested and a new joint formed. The head of the bone is small and deformed and the real acetabulum obliterated. Compensatory changes appear in the pelvis, which is tilted forward, and the lumbar spine, which is curved forward. If one hip alone is involved, there is an additional lateral curvature, and the child limps; if both are involved, there is no limp, but the

gait is peculiar. The tilting of the pelvis can be made to disappear by placing the child upon its back and flexing the thighs.

The prognosis as to the utility of the limb is fair. The patient will probably be able to get about, and the deformity will grow no worse.

Treatment.—Inasmuch as operative treatment has a very high mortality and often enough gives but little or no relief, while, on the other hand, some cases—double as well as single—reach adult life, undiagnosed and untreated, with comparatively-slight deformity and no disability except a waddling gait, it is proper—Hoffa and Lorenz to the contrary notwithstanding—to institute treatment by palliative measures. For unilateral dislocations an elevated sole to the shoe, and, if necessary, an apparatus to prevent the head of the femur from riding up any higher on the ilium, fulfill the indications. Or in cases under 5 or 6 years of age—single or double—prolonged traction, for even as long as two years, may produce material and permanent improvement. Mikulicz claims to be able to effect reduction by manipulation. An injection of a 10-per-cent. solution of zinc chloride above the head of the bone has been advocated for the purpose of strengthening, by new bony formation, the upper rim of the new acetabulum.

Of the operations, that of Lorenz is a type. He makes a vertical antero-external skin incision, divides the fascia lata transversely, separates the muscles, frees the bone by a cross-cut in the anterior surface of the capsule, gouges out the old acetabulum, making a strong upper rim to it, and replaces the bone by extension, aided by a traction apparatus. Immobilization is replaced by passive motion at the end of four weeks, and the

child begins to walk with assistance two weeks later. No further apparatus is used. In difficult cases Lorenz advises a preliminary course of two weeks' extension by a thirty-pound weight.

Congenital shoulder dislocations are to be treated according to similar principle.

The anterior knee dislocations are easily reduced, and a good functional result may be predicted.

Pathological Dislocations.—Paralytic ("myopathic") dislocations occur usually in the shoulder, where the deltoid and scapular muscles form such important accessories to the joint.

Dislocations by effusion, erosion, or other articular processes occur in the course of the eruptive, continued, or rheumatic fevers. The hip is commonly affected.

Special Dislocations.

DISLOCATIONS OF THE LOWER JAW.—The dislocations may be single or double. Upward or backward dislocations are very rare. In the former the condyle is driven through the base of the skull, in the latter back through the anterior wall of the external auditory meatus.

Forward Dislocations.—The lower jaw projects forward, the mouth cannot be closed, the condyles may be seen and felt in front of the eminentia articularis. The glenoid fossa is empty. In unilateral dislocations the chin is deviated to the opposite side. The pain is usually not great.

The usual cause of forward dislocations is a wide opening of the mouth in yawning, laughing, or introducing some large object. It is more frequent in women than in men. When the mouth is wide open the external lateral ligament is relaxed and the external pterygoid muscle draws the condyle, and the interarticular cartilage with it, well forward on the eminentia articularis. A slight

overaction of this muscle carries the condyle over the summit, whence it plunges forward and upward under the zygoma, and is then held by the balance of forces between the muscles pulling upward and forward and the external lateral ligament pulling upward and backward. The interarticular cartilage accompanies the condyle, at least part of the way. The capsule is not torn.

Reduction is accomplished by opening the mouth more widely to relax the ligament and then pressing the condyle backward and then a little downward. A fairly-successful method is by grasping the jaw on either side with the thumbs on the molar teeth and the fingers under the jaw outside. As the jaw snaps back the thumbs must be quickly slipped into the hollow of the cheeks to avoid being bit. Reduction of one side at a time is sometimes easier. Anæsthesia may be required to overcome the contraction of the muscles.

Not infrequently this dislocation tends to become habitual. To overcome this the meniscus may be sutured in place. Injection of tincture of iodine has been proposed.

DISLOCATIONS OF THE SPINE.—Dislocation of the lumbar and dorsal vertebræ is almost always complicated by and confounded with fracture. Extension and local pressure have occasionally effected reduction; operative treatment should be resorted to in hopeful cases.

DISLOCATIONS OF THE OCCIPUT (from the atlas) and the atlas (from the axis) have been diagnosed post-mortem. Laceration of the vertebral arteries and the medulla, with or without fracture of the odontoid process, causes instant death in most cases.

DISLOCATION OF THE LOWER CERVICAL VERTEBRÆ.—This may be double or single, complete or incomplete, for-

ward or backward, or bilateral in opposite directions. If the dislocation is unilateral (forward), the head is turned to the opposite side, on which side the muscles are contracted. On the side of the dislocation the dislocated bone may be felt, and its spinous process is deflected toward that side. In bilateral forward dislocations the head may be bent far forward and the dislocated bone (usually the fifth) felt in the back of the neck, or the head may be extended and the bone palpable within the pharynx. The symptoms depend upon the amount of injury to the cord. Damage to the cord above the third cervical vertebræ causes death by cutting off the phrenic nerves. Below this point the result will be a paralysis more or less durable according to the nature of the lesion.

The mechanism of the unilateral forward and bilateral dislocations in opposite directions is abduction (lateral flexion) and rotation, by which the inferior articular process of the upper vertebra is lifted over the superior process of the lower one. Bilateral forward dislocations are caused by hyperflexion, backward by hyperextension and direct pressure.

Treatment.—Reduction should be attempted at once. Unilateral dislocations are to be reduced in the way they were produced; *i.e.*, by abduction and rotation, aided by direct manipulation, so as to lift the disarticulated bone back into place.

Traction and local pressure have proved effectual in the reduction of bilateral dislocations.

After the reduction the patient should be kept quiet for some weeks. A plaster-of-Paris splint for head and neck is advisable.

These means failing, if there seems any hope of recovery by renewing the

pressure from the cord, the dislocation should be cut down upon aseptically and an attempt made to reduce it by removing such ligamentous or bony obstacles as may exist.

DISLOCATIONS OF THE STERNUM.—Dislocations—forward or backward—of the body from the manubrium are usually accompanied by serious interference with respiration and circulation. From fracture the diagnosis is made by finding the second costal cartilages attached to the manubrium and torn from their articulation with the body. Inasmuch as the injury is due to great violence, direct or indirect, the associated injuries play a large part in the prognosis. Reduction is effected by dorsal flexion and direct pressure.

DISLOCATIONS OF THE ENSIFORM PROCESS are a tilting either forward or backward. The symptoms are pain and persistent vomiting. Pressure with the fingers or with a sharp hook introduced underneath the skin will reduce the dislocation.

DISLOCATIONS OF THE RIBS AND COSTAL CARTILAGES.—The ribs may be dislocated forward from the spine or forward or backward from each other or from their costal cartilages. The cartilages may be dislocated from the sternum.

The symptoms and treatment are the same as of fracture of the ribs. Reduction, followed by the application of a tight head-band of adhesive plaster three-fourths of the distance around the chest.

Chondro-sternal dislocations usually recur.

DISLOCATIONS OF THE INNER END OF THE CLAVICLE.—The clavicle may be dislocated forward, backward, or upward, in this order of frequency.

Forward dislocation may be complete or incomplete. The head of the bone is

prominent and may be displaced inward. The shoulder sinks downward and inward. The arm is useless. There is local pain. This dislocation is usually caused by a forcible depression and pushing backward of the shoulder, by which the centre of the clavicle comes to rest on the first rib, and on it as a fulcrum the inner end is pried upward and forward. By pulling the shoulder upward and backward and pressing on the dislocated bone reduction is effected; but retention is often difficult. Dorsal decubitus with a figure-of-8 bandage about the two shoulders, the turns crossing in the back, may prove effective or may be reinforced by direct pressure by a molded plaster-of-Paris splint, a hernial truss, or a pad retained in position by adhesive plaster, or a figure-of-8 bandage, crossing in front. If all precautions fail and the dislocation becomes habitual, two or three biweekly injections of alcohol with immobilization may be attempted, or the capsule exposed and shortened.

Backward dislocations may be either complete or incomplete. The head of the bone passes backward and may compress any of the important structures at the root of the neck. This dislocation may be caused by direct violence or by forcing the shoulder forward and inward. Reduction is effected and maintained by drawing the shoulder backward and outward and retaining it in that position.

Upward dislocation is caused by depression of the shoulder. The head of the bone rests on the episternal notch, having passed behind the sternal head of the sterno-mastoid. Reduction is made by drawing the shoulder upward and outward and pressing the head of the bone down. Here, again, retention is difficult, and Malgaigne's patellar hooks have been suggested as an adjunct to the treatment.

DISLOCATIONS OF THE OUTER END OF THE CLAVICLE.—The usual variety is upward or upward and outward. Rarely a subacromial dislocation occurs. The so-called subcoracoid dislocations are probably mythical.

Upward Dislocation.—The acromial end of the clavicle rises more or less above the acromion, and may be displaced outward over it. There is frequently fracture of the articular edges. The usual cause is a blow on the shoulder.



Fig. 3.—Adhesive-plaster dressing for upward dislocation of acromial end of clavicle. (*American Text-book of Surgery.*)

Reduction is easy, retention difficult. Although non-reduction causes almost no loss of function and but little deformity, Stimson's retention dressing is recommended for its simplicity and efficiency (Fig. 3). A long strip of adhesive plaster three inches in width is placed with its centre under the point of the flexed elbow and its ends carried up in front of and behind the arm, crossing over the end of the clavicle, and secured to the front and back of the chest,

respectively, while the bone is held in place by pressure upon the clavicle and elbow.

Recurrence can be readily detected through the plaster. For additional security the forearm should be supported in a sling, and the arm bound to the chest. Care must be exercised not to cause pressure sores over the bony prominences at the elbow.

SUBACROMIAL DISLOCATIONS.—A few cases are recorded in which the outer end of the clavicle was forced down and caught under the acromion. Direct violence and muscular action are the re-

applied obliquely in the bony surface and directly on the capsule of the joint, through which the head of the bone is then forced.

Varieties.—Four divisions may be made according to the direction in which the head of the bone leaves the socket, and these subdivided according to the point at which it comes to rest, or according to the position of the limb, as follows:—

Anterior.....	{ Subcoracoid (most common). Intracoracoid (exceptional). Subclavicular.
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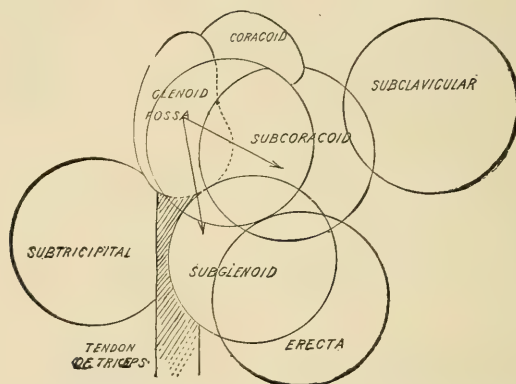


Fig. 4.—To show the range of positions that may be taken by the head of the humerus after primary displacement forward or downward in any of the directions between the arrows. (*Stimson, "Dislocations."*)

corded causes. Reduction was easy by drawing the shoulder outward, and there was tendency to recurrence in only one case.

DISLOCATIONS OF THE SHOULDER.—These dislocations are as numerous as all other dislocations taken together. They are rare in youth and old age, and more frequent in men than in women. This frequency is explicable by the exposure of the joint to trauma and its conformation. The glenoid cavity covers such a small part of the head of the humerus that, in extreme degrees of abduction, extension, or flexion, any force transmitted through the shaft of the bone is

Downward...	{ Subglenoid (uncommon). Erecta (very rare). Subtricipital.
Posterior.....	{ Subacromial (rare). Subspinous (very rare).
Upward.....	{ Supraglenoid (very rare).

In the anterior dislocations the displacement is also more or less downward (and, of course, inward), and in the downward ones it is usually also forward and inward. Thus, the two classes merge into each other. The term "subglenoid" is restricted to those cases in which the head of the bone is very low, others of this class being called "subcoracoid."

The accompanying figure (Fig. 4) will demonstrate the different positions assumed by the head of the bone in the anterior-and-downward dislocation.

Anterior Dislocations.—The subdivisions of this variety are dependent on the increasing amount of inward displacement of the head of the bone, and grow less frequent in the same order; namely, subcoracoid, intracoracoid, and subclavicular.

Subcoracoid.—The head of the humerus lies beneath the coracoid process, in contact with it or at a variable distance—a finger's breadth at most—below it. The head may be displaced inward until three-fourths of its diameter lies to the inner side of the process (farther inward would be subcoracoid) or it may be simply balanced on the anterior edge of the glenoid fossa. The elbow hangs away from the side and the deltoid fullness of the shoulder is lost (Fig. 5). The axis of the humerus is sure to pass to the inner side of the glenoid fossa, and palpation reveals the absence of the usual bony resistance below the outer side of the acromion, and the presence of an abnormal resistance below the coracoid process, in the axilla, which partakes of rotary movements communicated to the arm. Voluntary movement is usually lost. Passively the arm can be abducted, but not adducted; so that the elbow touches the chest, while the fingers rest on the opposite shoulder. Measurement in abduction shows shortening.

The diagnosis is usually easily made by finding the glenoid cavity empty, the head of the bone beneath the coracoid, and by eliciting the above-mentioned sign. If there be fracture of the anatomical neck the head will not participate in movements imparted to the shaft, and crepitus can usually be elicited.

Causes.—Direct violence, by a blow

under the shoulder, indirect, as by a fall upon the hand; by leverage in forcible abduction and outward rotation; or by muscular action in any of the above ways.

Pathology.—The capsule is torn at its inner and lower portion, or, more rarely, stripped up, and with it may be torn the circumflex nerve, the posterior circumflex artery, and subscapularis (Fig. 6). In "typical" cases the outer and upper portions of the capsule remain untorn and aid in determining the abduction.

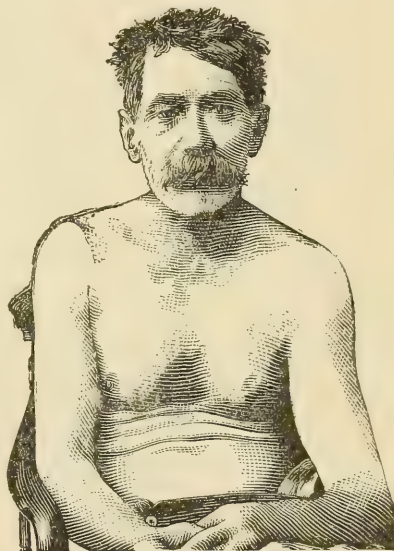


Fig. 5.—Subcoracoid dislocation of the left shoulder. (Stimson, "Dislocations.")

The supraspinatus, infraspinatus, and teres minor may be torn away (in decreasing order of frequency) from the great trochanter or there may be avulsion of more or less of the trochanter itself. With avulsion of the trochanter the tendon of the long head of the biceps may slip to the outer side of the bone and oppose reduction (rarely). This tendon may also be torn. The head of the humerus is often bruised and ground by impact with the edge of the glenoid cavity, which, in turn, is splintered.

Treatment.—In uncomplicated cases reduction is usually easy by Kocher's method, as follows:—

The elbow is flexed to a right angle and pressed closely to the side; then the forearm is turned as far as possible away from the trunk,—external rotation of the arm (Fig. 7). Maintaining the external rotation, the elbow is carried well forward and upward,—flexion of the arm (Fig. 8); and finally the hand swept

After a long, steady pull, manual or elastic, the deltoid may yield and allow the head of the bone to be pushed back into place. Or, after a few moments of traction, the arm is violently adducted over the closed fist in the axilla (this is safer than the heel). If anæsthetics are used all of these violent measures should be executed very cautiously.

Dr. Cole suggests a method which he claims is successful in a large number of

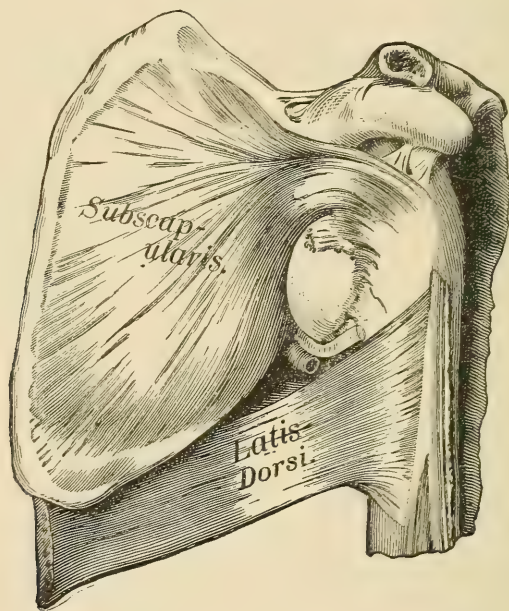


Fig. 6.—Subcoracoid dislocation on a cadaver, showing rupture of lower part of subscapularis. (B. Anger; Stimson, "Dislocations.")

over until it touches the chest,—inward rotation (Fig. 9),—the elbow being simultaneously lowered. Anæsthetics may or may not be necessary. If, after the "first movement," the head does roll out in front of and below the acromion, the attempt will fail. Direct manipulation of the head may be of assistance.

If Kocher's method fail, traction downward and outward (never upward and outward, on account of the danger of lacerating the vessels) should be tried.

cases. The surgeon, standing by the patient's side, holds the arm abducted and the elbow flexed, and, while distracting the patient's attention, gently oscillates the arm. As the deltoid is seen to relax, a sharp blow is delivered into the fold of the elbow and the arm rotated sharply outward, thus rolling the bone into place.

If judicious attempts at reduction by these methods fail, even under anæsthesia, an open arthrotomy should be

done for the purpose of discovering and removing the obstacle to reduction.

In intracoracoid dislocations the head



Fig. 7.—Kocher's method of reduction by manipulation. First movement, outward rotation. (Appi, "American Text-book of Surgery.")

is displaced farther inward and the symptoms are those of the subcoracoid, except that the head of the humerus is felt farther displaced and the shoulder is

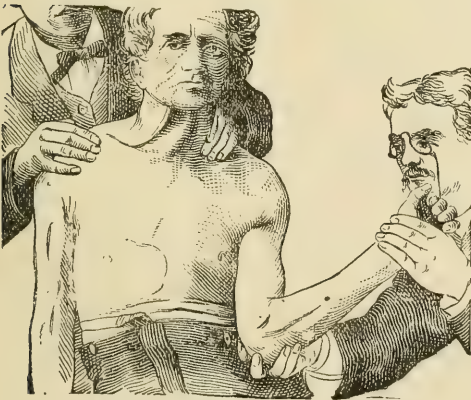


Fig. 8.—Kocher's method of reduction. Second movement, elevation of elbow (Appi, "American Text-book of Surgery.")

more flattened. The arm may be fixed in horizontal abduction. The cause of this particular dislocation is, as a rule,

an unusual amount of laceration of the capsule and subscapularis, which allows the head of the bone to slip higher into the axilla. Reduction by outward traction is easy unless the subscapularis or a torn portion of the capsule intervene. In such cases operation is the only recourse.

In subclavicular dislocations the same forces acting more energetically force the head of the bone up under the clavicle.

Downward dislocations include all cases in which the head of the bone lies

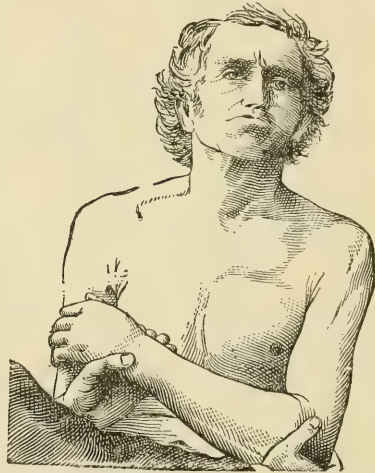


Fig. 9.—Kocher's method of reduction. Third movement, inward rotation and lowering of elbow. (Appi, "American Text-book of Surgery.")

below the glenoid fossa. In subtricipital dislocation, of which one case is recorded, the head of the humerus was displaced secondarily backward and upward behind the long head of the triceps.

Subglenoid Dislocations.—The symptoms are those of subcoracoid dislocation; but abduction and flattening of the shoulder more marked. The head of the bone is palpable below its socket. The upper part of the greater tuberosity is habitually torn away. The usual cause

is forcible abduction followed by rotation or impulsion.

Treatment.—Traction in moderate abduction with direct pressure.

Luxatio Eucta.—Very rarely, by forcible elevation of the arm the head of the bone is displaced so far downward that the extremity maintains its erect position. It is reduced by upward traction until the head falls into place.

Posterior Dislocations.—The two varieties differ only in the extent of displacement.

Symptoms.—The arm is adducted and rotated in, the elbow being directed slightly forward. The shoulder is flat in front and full behind (when the head of the bone may be felt). Passive motion is restricted, voluntary motion absent.

The cause is direct pressure outward and backward, or the pressure exerted in the same direction along the adducted and inward-rotated humerus.

The outer side of the capsule is torn and the external and internal scapular muscles more or less lacerated or avulsed with fragments of the tuberosities. The head of the bone lies on the outer edge of the glenoid fossa, or farther back beneath the spine of the scapula, or on the infrapinatus.

Treatment.—Reduction is accomplished by traction and direct pressure forward. Avulsion of the subscapularis makes recurrence probable. Unreduced dislocations backward are accompanied by an unusual amount of disability.

Upward Dislocations.—These are extremely rare. The head of the bone is forced upward between the coracoid and acromion, usually to above the clavicle. The arm is almost immobilized in adduction and slight extension. Reduction may be effected by downward traction.

Complications of Dislocations of the Shoulder.—Compound dislocations are

very rare, and are commonly caused by direct violence. The skin-wound is usually in the axilla. Aside from complications which may exist not dependent on the dislocation, the great dangers are from laceration of the main arteries (frequent) or nerves (unusual) and from supuration. The treatment consists of enlarging the wound until the extent of damage can be fully appreciated and, as far as possible, repaired. Meanwhile the wound should be thoroughly irrigated with "normal" salt solution. The dislocation may now be easily reduced. In most cases thorough drainage should be provided for, and in some cases it may be advisable to excise the head of the humerus to this end to oppose ankylosis.

Fractures of the various bony prominences of the scapula and humerus have commonly a purely pathological importance. Fractures of the anatomical or surgical neck of the humerus are important, but often difficult to diagnose. The diagnostic points of fracture of the anatomical neck are the recognition of the head in the axilla and its failure to move with the shaft, the maintenance of near-by normal range of motion and the normal position of the greater tuberosity. Crepitus may sometimes be elicited. In fracture of the surgical neck the signs are quite the same, except that the tuberosity is displaced with the head, and, with it, fails to move with the shaft, and crepitus is more easily elicited. In either case the upper fragment may be reducible by direct manipulation. This failing, if the fragments can be approximated, the arm may be immobilized for three or four weeks in an appropriate position with the hope of obtaining union and effecting reduction at the end of that time by manipulation. But the better plan is probably to do an open arthrotomy and reserve the upper frag-

ment except in such fractures of the surgical neck as can be reduced, and to this end the use of a strong right-angled hook inserted into a hole drilled at the lower end of the upper fragment, may be of great service (McBurney). Or a fairly-useful false joint may sometimes be obtained at the point of fracture.

INJURIES TO VESSELS AND NERVES.—The axillary itself is very rarely ruptured, and hence the radial pulse may persist, even though there be serious damage to the arteries about the joint. This damage is usually due to ill-advised attempts at reduction, and is recognized by the rapid extravasation of blood down the arm and into the axilla. Treatment is by pressure, ligature of the axillary or subclavian, or disarticulation of the shoulder. The mortality is very high. The circumflex nerve is often torn, with a resulting temporary or permanent disability of the deltoid and anæsthesia of the shoulder.

TREATMENT OF OLD UNREDUCED DISLOCATIONS.—If the dislocation cannot be reduced after loosening adhesions by forcible (yet judicious) rotation and traction, operation is advisable for reduction by division of the soft parts, or for excision of the head of the bone. A very serviceable joint may be obtained by the latter method; but as the line of divisions of the bone runs below the tuberosities, rotation is practically lost.

Habitual dislocation has been cured by reefing the anterior portion of the capsule. Ricard advises the usual anterior incision between the deltoid and pectoralis, supplemented by a horizontal one along the clavicle and dissection back of the anterior part of the deltoid.

DISLOCATIONS OF THE ELBOW stand second in order of frequency, and are most common in persons under twenty-five. Among the great variety of forms

of dislocations of both bones, the backward are by far the most frequent.

The divisions and subdivisions are as follows:—

- | | | |
|--|---|---|
| Dislocations of both Bones of the Fore-arm | { | 1. Dislocations backward :
and outward.
and inward. |
| | | 2. Lateral dislocations :
Incomplete { inward.
outward. |
| | | Complete { outward. |
| | | 3. Forward dislocations :
Incomplete (first degree).
Complete (second degree).
With fracture of the olecranon. |
| Dislocations of Ulna Alone | { | Backward and Upward { Incomplete (first degree).
Complete (second degree). |
| | | Backward and Outward (behind the radius).
Inward (one case). |
| Dislocations of the Radius Alone | { | 1. Backward. |
| | | 2. Outward. |
| | | 3. Forward. |
| | | 4. By elongation (the subluxation of children). |
| | | 5. With fracture of the ulna. |

Dislocations of Both Bones Backward.

—The inward and outward subvarieties are of no practical importance.

Symptoms.—The elbow is swelled and partly flexed. The olecranon may be felt displaced backward from the epicondyles and the head of the radius may be recognized behind the external epicondyle as a bony point which rotates with the forearm. The trochlear surface may be prominent in the bend of the elbow; the tendon of the biceps behind. Passive flexion and extension are moderate. There is abnormal lateral mobility in full extension.

The cause is most commonly a fall upon the outstretched hand forcing the two bones backward. The coronoid process of the ulna is either broken or lifted

over the trochlear surface by hyperextension or by abduction, which increases the normal outward deviation of the forearm and a twist which swings the process downward and then backward.

Pathology.—The internal lateral ligament is torn, and the external one either torn or stripped away with the periosteum from the external condyle. Hence, in old dislocations reduction is effectually prevented by the mass of callus that forms beneath this elevated periosteum behind the external condyle. The front of the capsule is torn, the epitrochlea (internal epicondyle) may be broken by muscular action, or the muscles attached to it may be ruptured. Fractures of the head of the radius and coronoid process are rare. The latter, however, does not interfere with the action of the brachialis anticus, as that muscle is attached to the base of the process: a part not interested in the fracture.

Treatment.—Forcible flexion is to be condemned as unscientific and less likely to succeed than pressure on the dislocated bones combined with traction of the forearm in moderate extension or hyperextension. Usually the dislocation is easily reduced. Sometimes anæsthetics are necessary. After reduction the limb should be immobilized by bandages and a sling for about three weeks, after which mild massage and active motion will gradually remove the stiffness. Early passive motion will not hasten the result, and may even increase the excessive production of callus which, in children, sometimes goes on even after reduction and may cause serious limitation to the motion of the joint.

Lateral Dislocations.—Incomplete dislocations in either direction are said to be frequently overlooked or mistaken for fractures. The cause of lateral dislocations is usually a fall upon the hand by

which the normal outward angle at the elbow is increased by tearing of the internal lateral ligament and a downward movement of the ulna, directly away from the trochlea. The head of the radius then glides either outward or inward, as the case may be, the ulna following.

In incomplete inward dislocations the forearm is pronated and slightly flexed; its long axis parallel to and a little to the inner side of that of the arm. The olecranon and external condyle are prominent, and the head of the radius can be felt displaced downward and inward, resting below the trochlea (the greater sigmoid cavity of the ulna embraces the epitrochlea). Flexion and extension are but little interfered with. Reduction is made by traction and direct pressure. In unreduced cases there is very little disability, and operative interference is probably inadvisable.

Incomplete Outward Dislocations.—The forearm is pronated and slightly flexed, and its long axis is to the outer side of and parallel to that of the arm or else in abduction. The ulna is displaced so that the central ridge of the greater sigmoid cavity has passed beyond the outer rim of the trochlea; the radius lies partly below or entirely beyond the external condyle. The internal condyle and olecranon are prominent.

Treatment.—The ridge of the sigmoid cavity must be unlocked from the groove between the trochlea and capitellum. This is done by traction or hyperextension (or by abduction, if the head of the radius rests below the external condyle and can be used as a fulcrum). Then the bones are pushed easily into place. The broken epitrochlea may lodge in the groove of the trochlea and effectually prevent reduction. Even if the disloca-

tion be not reduced, the joint may be quite useful.

Complete outward dislocation occurs in three forms. In the simplest form the bones of the forearm are displaced directly outward, the inner edge of the olecranon resting against the outer side of the external condyle. If, now, the forearm is flexed and strongly pronated, the second form (subepicondylar) is produced, in which the anterior surface of the ulna looks inward and its sigmoid cavity embraces the outer side of the external condyle, while the radius lies above it, with its head in front of the epicondylar ridge. In the third form (supra-epicondylar) the dislocated bones are moved still further upward and backward, so that their articular surfaces lie external to and behind the supinator ridge. Reduction is usually easy, owing to the extensive laceration to ligaments; but, even if unreduced, the elbow remains fairly strong and mobile.

Forward Dislocation.—This rare injury is usually caused by direct trauma to the back of the flexed elbow. The olecranon was broken in about a third of the cases. If this is the case, the ulna and radius are displaced forward and upward in the anterior surface of the humerus; but, if the olecranon remains intact, it may rest on the trochlea, or, the triceps being torn away, it may pass to the front of the humerus. Reduction by traction appears to have been easily accomplished.

DIVERGENT DISLOCATIONS OF THE RADIUS AND ULNA.—In the antero-posterior variety the ulna lies behind and the radius in front of the humerus; in the transverse the ulna is displaced inward and the radius outward. The usual cause seems to be abduction followed by internal rotation and impulsions. Reduc-

tion has failed in one-quarter of the cases.

DISLOCATION OF THE ULNA ALONE.—The forearm is usually extended and adducted. Flexion is painful; rotation free. The trochlea is prominent in front and the olecranon behind, while the head of the radius remains in place. The cause of the injury appears to be hyperextension or abduction, followed by adduction and inward rotation. The rational method of reduction is by supination, abduction, and hyperextension (von Pitha).

DISLOCATION OF THE RADIUS ALONE.—Of the dislocations backward, outward, and forward the last is the most frequent, being, in fact, of not unusual occurrence in connection with a fracture of the shaft of the ulna from a fall upon the hand. The head of the bone is displaced upward in front of the external condyle. The orbicular and anterior ligaments are torn. Abduction is possible, while supination, flexion, and adduction are all limited. Adduction and pressure appears to be the best method of reduction; but the orbicular ligament may be interposed and require operative interference. The backward and outward dislocations are very rare. They necessitate a fracture of the ulna or a rupture of the interosseous membrane.

The downward dislocation (dislocation by elongation, subluxation of young children) is of frequent occurrence. The clinical history is quite characteristic: a child, usually under three years of age, is pulled by the hand; it cries out, and refuses to use the limb, which hangs with the forearm partly flexed and pronated. The region of the head of the radius is sensitive to pressure, and sometimes an interval can be felt between the radius and the condyle. All passive motions, except supination, are free. On forcible

supination a slight click may be felt and the symptoms are at once relieved. Duverney's theory of downward displacement with interposition of the annular ligament is most in accord with the facts.

OLD UNREDUCED DISLOCATIONS OF THE ELBOW.—Adhesions and new bone formation very soon immobilize the joint. If this immobilization occurs in extension, the position may be improved by forcible flexion, with or without fracture of the olecranon. A more accurate method, however, and one likely in many cases to afford fairly-good functional re-

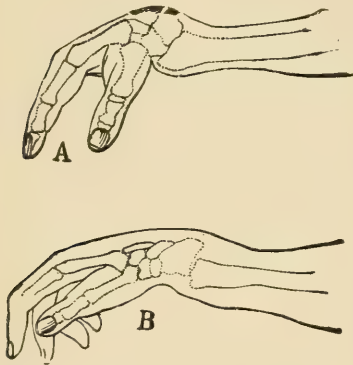


Fig. 10.—Diagrammatic, to indicate the deformity in (A) dislocation of the wrist backward and (B) Colles's fracture of the radius. (*Stimson.*)

sults, is arthrotomy. The chief obstacle to reduction will be found to be the new bone in the great sigmoid cavity. This may be removed and adhesions divided through two lateral incisions, or a U-shaped incision with division of the triceps or olecranon.

DISLOCATIONS OF THE LOWER RADIO-ULNAR JOINT.—The ulna is spoken of as the dislocated bone. It may be dislocated forward or backward. The latter variety is caused by exaggerated pronation, and the former by direct trauma. Both are easily reduced.

DISLOCATIONS OF THE CARPUS FROM THE RADIUS.—These may be complete or incomplete; forward, backward, or outward. In the incomplete form the cuneiform maintains its relations to the triangular fibrocartilage, while the scaphoid and semilunar are dislocated from the radius. In one case the semilunar alone was not displaced (backward). These dislocations may be complicated by fracture of the anterior or posterior ("Barton's fracture") lip of the radius; but this in no way complicates the treatment and is a purely secondary matter.

The more common Colles fracture of the lower end of the radius was long confounded with backward dislocation. The differential diagnosis is easily made by attention to the relations of the styloid process of the radius with that of the ulna and with the projecting mass on the back of the wrist (Fig. 10). Reduction in either case is made by dorsal flexion and direct pressure, and after reduction the differential diagnosis is easy.

The spontaneous forward dislocation of Madeburg occurs slowly in adolescents as the result of absorption of the anterior part of the articular surface of the radius. The ulna is abnormally prominent; dorsal flexion is limited.

DISLOCATIONS OF THE CARPAL BONES. Dislocations have been reported of each of the carpal bones except the cuneiform. If the bone cannot be pressed into place, and gives rise to annoying symptoms, it had better be removed.

A few dislocations of the second row of carpal bones upon the first have been reported.

CARPO-METACARPAL DISLOCATIONS.—The first metacarpal is the one most commonly dislocated; the dislocation is usually backward and incomplete. The base of the dislocated bone forms a distinct prominence on the back of the

hand; this is readily reduced, but as readily recurs. To prevent recurrence, extension of the finger (and also abduction, if it be the thumb) and direct pressure on the head of the bone must be maintained by a dorsal splint for one or two weeks. Habitual dislocations of these joints are often quite painful.

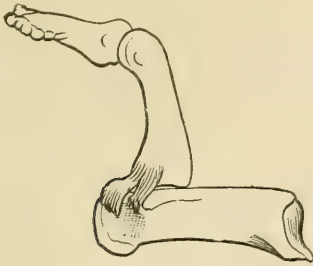


Fig. 11.—Simple complete dislocation of the thumb. (*Farabeuf.*)

DISLOCATIONS OF THE THUMB AND FINGERS.—*Metacarpo-Phalangeal Dislocations of the Thumb.*—Lateral (one case) and forward dislocations present no especial points of interest. The latter are easily reduced by hyperflexion and traction. Backward dislocations of this joint, however, have long been the subject of controversy, and are treated in some of our latest text-books in a manner none too accurate. This dislocation may be incomplete, complete, or complex. Incomplete backward dislocations may be produced voluntarily by many young persons. It is reduced at will. In the complete form the phalanx is carried backward and upward on the dorsum of the metacarpal, usually by forced extension, the anterior ligament is torn away from the metacarpal bone and drawn backward with its sesamoid bones along, and even past, the articular surface of the head of the metacarpal, while the tendon of the long flexor slips to one side of the head, usually the inner, although it may exceptionally remain in

place. The first phalanx is in extension at a right angle, the terminal phalanx in flexion, and the head of the metacarpal prominent in the thenar eminence (Fig. 11).

In the complex form (produced from the complete by forced flexion of the thumb) the glenoid ligament, and the two sesamoid bones with it, are turned upward so as to lie between the phalanx and the head or dorsum of the metacarpal. The thumb is in straight extension, parallel and posterior to the metacarpal; its base can be felt as a prominence behind, and the head of the metacarpal protrudes in front. The sesamoid bones stand at a right angle to the articular surface of the phalanx, and cannot be folded under it, thus offering a great—often insurmountable—obstacle to reduction. The essential point of reduction, therefore, is to avoid the transformation of the complete into the complex form. The extension must be maintained or even increased and the thumb pressed bodily downward until the anterior edge of its base, following the glenoid ligament, overlaps the articular surface of the metacarpal, when it can be turned into place by flexion. If this fail, a combination of rotation with the



Fig. 12.—Complex dislocation. (*Farabeuf.*)

downward pressure may succeed: a sort of unbuttoning of the head of the metacarpal from the grasp of the glenoid ligament and the attached heads of the short flexor. If, however, the dislocation has become complex by the interposition of the glenoid ligament, the same method may yet succeed; but much more for-

cible downward traction is necessary to carry the edge of the ligament over the end of the metacarpal bone ahead of the phalanx before instituting flexion. If all manipulations fail, the joint must be opened through a longitudinal anterior incision, and the centre of the glenoid ligament nicked deeply enough to allow it to be drawn over the head of the metacarpal, after which the dislocation may be readily reduced.

Metacarpo-phalangeal dislocations of



Fig. 13.—Dorsal dislocation of femur.
(Cooper.)

the fingers present the same features as those of the thumb, save that they usually have no sesamoid bones.

Dislocation of the phalanges may occur in any direction. Reduction is usually easy, though it is possible that the thick anterior ligament may be interposed, as in the metacarpo-phalangeal joint.

DISLOCATIONS OF THE PELVIS AND COCCYX.—Dislocation of the pubic and sacro-iliac symphyses occurs in connection with fracture of the pelvis, the symp-

toms and treatment of which it does not materially complicate.

The coccyx may be dislocated forward or backward. The pain is usually intense. Diagnosis and reduction are effected by rectal touch. The tendency to recurrence can only be remedied by excision of the bone.

DISLOCATIONS OF THE HIP.—These form from 2 to 10 per cent. of all dislocations; they occur at all ages and are more common in men than in women. The head of the femur may leave its socket in any of the four principal directions, after which it assumes various positions by secondary displacement. In "typical" dislocations the Y-ligament remains untorn and determines the characteristic attitude of the limb (Bigelow). Compound dislocations are rare. The varieties are as follows:—

Dislocations { "Typical" dorsal (comprising the iliac and "ischiatric," and those Backward { "upon the dorsum ilia" and "into the ischiatic notch").

Dislocations { Anterior oblique. Backward { Everted dorsal (comprising the "supraspinous" and some of the "supracotyloid").

Dislocations Downward { Obturator. and Inward { Perineal.

Dislocations { Forward { Ilio-pectineal. and Upward { Suprapubic { Pubic. Intrapelvic.

Dislocations directly upward (supracotyloid or subspinous).

Dislocations downward on the tuberosity of the ischium.

Backward Dislocations.—The dorsal form is by far the most common of the dislocations of the hip. The thigh is adducted, rotated inward, and more or less flexed; so that the knee rests upon the front of the opposite thigh when the patient is recumbent, and there is apparent shortening (Fig. 13). The upper and outer part of the thigh is broadened, and the trochanter is above Nélaton's line (a

line drawn from the antero-superior spine of the ilium to the tuberosity of the ischium). The head of the femur may be obscurely felt in the buttock.

The actual shortening cannot easily be determined on account of the difficulty of placing the two limbs in symmetrical positions. Voluntary movement and friction are lost; passive flexion and adduction alone are possible.

The characteristic position and limitation of motion readily distinguishes the dislocation from a fracture of the neck of the femur.

Etiology.—The dislocation is usually produced by violence transmitted along the shaft of the femur while the thigh is flexed, adducted, and rotated inward; or the head of the bone may be thrown out of place by exaggerated adduction, inward rotation, and slight flexion; or, again, the dislocation may result secondarily from an obturator dislocation by the same three motions.

Pathology.—The head of the bone usually tears through the capsule low down behind, passes below and then upward behind the obturator, and rests finally on that muscle close behind the acetabulum, or, more rarely, it leaves its socket higher up, pushes the obturator ahead of it outward or upward, and lies on the edge of the acetabulum itself. The capsule is irregularly torn behind, the ligamentum teres is ruptured, the quadratus femoris and gemelli are usually torn, the two obturators and pyriforms less frequently. Rarely the head of the bone rests on the great sciatic notch or the dorsum ilia. The edge of the acetabulum may be shattered and the head of the bone split.

Treatment.—The surgeon must endeavor to relax the Y-ligament and other untorn portions of the capsule, to bring the head of the bone opposite the rent

in the capsule (if necessary) and then to lift or pry it into place. To do this the patient is laid flat on his back and the pelvis steadied by an assistant or by the surgeon's foot. The patient's knee is then flexed at a right angle, the thigh rotated inward and flexed to or a little beyond a right angle, and then lifted bodily upward, rotated a little outward, and extended in abduction. The lifting and outward rotation should replace the bone with a distinct jump.

Or the patient may be laid on his face on a table, whose edge comes just above the groin, so as to leave the lower ex-

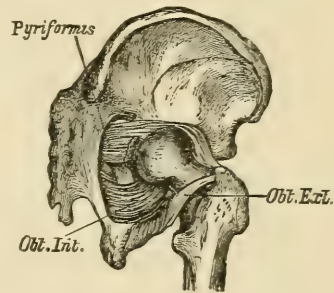


Fig. 14.—Dislocation below, and then behind and above, the obturator internus. (Stimson.)

trémities dangling. The sound limb is now held horizontally by an assistant, and the dislocated one allowed to hang vertically downward. The surgeon grasps the ankle of the dislocated limb, flexes the knee to a right angle, and, while diverting the patient's attention, swings the limb gently from side to side. Under the influence of gravity the muscles soon relax and the bone may slip into place of itself or aided by a sharp quick pressure downward on the calf.

If these methods fail, ether should be administered and reduction attempted several times by the first method. Failing again, try traction in slight flexion and adduction, aided by direct pressure on the great trochanter.

If the limb is too strongly flexed or too soon rotated outward the dorsal dislocation may be transformed into a thyroid one. If this occurs, the dislocation must be restored to its original form by reversing the movements: flexion in abduction and outward rotation, followed by adduction and rotation inward.

Everted Dorsal Dislocations.—If the outer branch of the Y-ligament is ruptured, the limitation to abduction and outward rotation is, in great part, removed, and the head of the bone is free to rise higher than before. Hence, when this rupture occurs, if the head remains behind the acetabulum only slight flexion and adduction persist, while, if it has moved upward and forward near to or above the antero-inferior spine of the ilium (in which position it can be felt), there will be extension, abduction, and slight outward rotation: the so-called everted dorsal. Reduction is effected by converting the dislocation into the common dorsal form and treating it as such.

Anterior Oblique Dislocation.—In Bigelow's one reported case the head of the bone was high above the acetabulum and the limb crossed the opposite thigh, everted, and with the knee extended. Reduction as for everted dorsal dislocation.

Dislocations Downward and Inward.—In both the obturator—or thyroid—and perineal varieties the head escapes through a rent in the lower and inner part of the capsule to lodge on the obturator foramen, or to proceed farther and rest on the perineum. In either case the limb is flexed, abducted, and rotated outward. It cannot be extended and can only be adducted after flexion. The limb is shortened, the trochanteric region flattened, and adduction tense. The head of the femur may sometimes be felt on the foramen, always if it is in the per-

ineum, in which latter case the abnormality of the position of the limb is much greater. Several patients are reported to have walked immediately after receiving a thyroid dislocation.

The common cause is violence received on the back of the pelvis while the thigh is somewhat flexed and abducted; but it may be extreme abduction alone. In perineal dislocations the laceration of the soft parts must be extensive.

Reduction is made by flexion of the hip to a right angle, traction with adduction, and then inward (or outward) rotation while lowering the knee. Manipulation may succeed with no rotation at all.

Dislocations Upward and Forward, and Inward and Forward (Suprapubic).—The limb is extended, markedly everted, and slightly abducted. The head of the femur is commonly to be felt in the groin (ilio-pectineal form) or may be above the pubes. The psoas-iliac and the great vessels are stretched across the head or may be ruptured. The head of the bone may have left the socket at its upper and inner part by hyperextension, or by abduction and outward rotation, or the dislocation may be secondary to an obturator dislocation.

Reduction.—The head is to be drawn downward past the pubic ramus by direct traction in the axis of the limb as it lies; then flexion is instituted while pressure is made against the head to prevent its moving upward again; and finally inward rotation replaces the bone.

Dislocations Directly Upward (Supracotyloid).—In the few recorded cases the head had been forced directly upward and lay just beneath the antero-inferior spine of the ilium. The limb was everted and abducted. Some of the patients have been able to walk with a limp.

These cases bear a close resemblance

to everted dorsal dislocations. No definite rules for reduction have been laid down.

Dislocation Downward Upon the Tuberosity of the Ischium.—This dislocation is very rare because of the ease with which it may be converted into a dorsal or thyroid dislocation. The thigh is sharply flexed and abducted. Reduction is easy by traction in flexion.

Complications of Dislocations of the Hip.—Compound dislocations are very rare.

Injury to the femoral vessels may occur in forward and inward dislocations.

Fracture of the neck of the femur is usually caused by overzealous attempts at reduction. Ankylosis with the limb in a favorable position is the best that can be hoped for, except possibly in the young, when excision of the head of the bone may give some useful motion.

Treatment of Old Unreduced Dislocations.—Of the operative procedures, reduction by arthrotomy gives a long list of deaths as opposed to two successes (by Parkes), while excision of the head, or of the head, neck, and trochanter, and subtrochanteric osteotomy have frequently decreased the disability. In many cases, however, the patients do reasonably well without operation, and these persons need expect no cure from the knife.

DISLOCATIONS OF THE KNEE.—These occur rarely and, in order of frequency, forward, backward, outward, inward, and by rotation. The dislocation is frequently compound, and the prognosis rendered much more grave by a complicating injury to either of the popliteal nerves or to the popliteal vessels. Even if, after reduction, pulsation reappear in the arteries of the foot, gangrene may supervene from thrombosis caused by laceration of the inner coats of the artery.

Forward dislocation may be complete,

or, more commonly, incomplete. When complete, the tibia may be displaced some distance upward over the front of the condyles. If the dislocation is compound, the wound is posterior and transverse. The cause is direct violence or hyperextension of the knee. Reduction is easily made by traction and pressure.

Backward dislocations may be complete or incomplete. The leg is usually either extended or hyperextended, and may be deviated to one side. The patella may be dislocated outward. The usual cause is direct violence. Reduction is effected by traction and pressure. Even without reduction a fairly-useful limb has resulted in several cases.

Lateral dislocations are outward or inward, complete or incomplete. The patella is usually deviated toward the side of the dislocation. The incomplete form is usually caused by abduction or (inward) by adduction. Reduction by traction and pressure. Dislocation by rotation is said to be incomplete when one condyle revolves around the other, complete when both revolve around a central axis. There may be additional backward or outward displacement. The rotation is said to be outward or inward according to the direction in which the toes turn. Reduction is easy. All knee-dislocations should be kept immobilized for several weeks after reduction.

DISLOCATION OF THE SEMILUNAR CARTILAGES.—Either cartilage may be detached from any of its ligamentous attachments, and so displaced in any direction, or it may be lacerated.

The symptoms are those of any loose body in the joint, sudden painful locking, usually after some given movement. The displacement may be recognized by palpation along the articular edge of the tibia. The cause of displacement is a

dislocation, a sprain, excessive rotation, or flexion.

Treatment.—The locking may be relieved by forcible manipulation or by pressure upon the displaced cartilage. Various braces have been devised to prevent recurrence, either by opposing the displacement directly or by preventing the motion which occasions the displacement. These methods failing, the cartilage may be removed or sutured into place through an exploratory incision alongside of the patella.

DISLOCATIONS OF THE PATELLA.—The patella may be dislocated outward or inward or rotated around its long axis, or

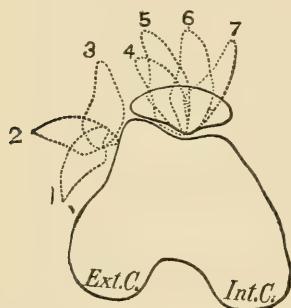


Fig. 15.—Diagram of the various dislocations of the patella. (*Stimson.*)

the two forms may be combined. Displacement upward or downward is purely secondary to rupture of the ligamentum patella or the quadriceps tendon, and need not be here considered.

Outward dislocation is complete or incomplete, and accompanied by various degrees of rotation (Fig. 15: 1, 2, and 3). The patella is readily felt in its new position, though it may be difficult to determine whether the outer or the inner border is directed forward. Muscular action or direct violence are the causes of the dislocation, and hydrarthrosis and ligamentous weakness are predisposing causes. The fibrous expansion of the vastus internus is ruptured, and the mus-

cle itself may be more or less torn. Reduction is made by direct pressure during extension of the knee and flexion of the hips.

Incomplete dislocations are those in which, during extension or flexion, the patella moves outward on to the external condyle.

Outward, Edgewise, or Vertical Dislocations (by Rotation).—In these the patella is moved outward and its inner edge backward into the intercondylar groove; so that its articular surface looks outward and more or less forward, or completely forward (Fig. 15: 4 to 7). The causes and treatment are the same as for outward dislocations.

Inward dislocations present the same features, *mutatis mutandis*, as the outward, but they are much less frequent.

Habitual dislocations are usually the result of some deformity, such as genu valgum. They are controlled by correcting the original deformity or by apparatus, or by tightening up the loose lateral ligaments (by operation).

DISLOCATION OF THE FIBULA.—The upper end may be dislocated outward and forward, or backward, or upward. These dislocations are all rare. The first form seems to be caused by muscular action of the long extension of the foot; the second (in more than half the cases) by action of the biceps, and the third by an injury resembling Pott's fracture, in which the fibula, instead of being broken, was forced upward.

A complicating fracture of the tibia may exist. Recurrence is likely, although reposition is easy, and hence immobilization should be maintained for several weeks.

The lower end may be dislocated backward. This is quite as rare as the dislocation outward in connection with Pott's fracture is common.

DISLOCATION OF THE ANKLE (TIBIO-TARSAL) BACKWARD.—By extreme plantar flexion the lateral ligaments are torn, the foot slips back, and the astragalus is caught behind the tibia. (Incomplete dislocation is a frequent accompaniment of Pott's fracture.) The malleoli may be fractured. The lengthening of the heel and shortening of the foot may only be determined sometimes by careful measurement.

Forward.—Rare. Caused by pressure on the heel or by exaggerated dorsal flexion.

Inward.—Two varieties. In the one the astragalus is pried out by suppuration and adduction, and the foot moved directly inward and forward; in the other (thought to be secondary to a backward dislocation) the foot is turned over so that its plantar surface faces directly inward. Reduction is easy.

Outward.—Appears always to be associated with Pott's fracture.

SUBASTRAGALOID DISLOCATIONS.—The other bones of the foot may be dislocated from the astragalus outward, inward and backward, forward, or backward. The first two are the most common. About 50 per cent. are compound. About 50 per cent. of attempted reductions have succeeded. Complicating fractures are not infrequent. Notwithstanding the persistence of the displacement, a good functional result may be obtained in some unreduced cases. Primary and secondary excisions of the astragalus and amputations give various results.

DISLOCATIONS OF THE ASTRAGALUS.—The varieties are forward, backward, outward and forward, inward and forward, and by rotation. There is frequently more or less rotation in connection with the other displacements.

Outward and Forward.—This is the

most frequent form. The foot is adducted and inverted and the external malleolus prominent. The astragalus rests on the outer cuneiform and cuboid bones, or even on the fifth metatarsal. Its posterior part is still in contact with the articular surface of the tibia. Reduction by traction on the foot and pressure on the astragalus is usually easy, unless the bone is rotated.

Inward and Forward.—The foot is abducted and everted and the astragalus lies in front or below the malleolus. Reduction may be prevented if the tendon of the tibialis anticus embraces the neck of the dislocated bone.

Forward.—Very rare. The cases reported have no features in common.

Backward.—There may be lateral displacement. In about 50 per cent. of cases the bone was broken at the neck and only the posterior fragment dislocated. There may be flexion of the terminal phalanx of the great toe. Reduction was effected in one-third of the simple cases.

Rotatory.—Dislocation by rotation alone may take place about the vertical or transverse axis (in these latter there is always some displacement forward and inward) or about the antero-posterior axis.

DISLOCATIONS OF THE TARSUS AND METATARSUS.—These dislocations resemble those of the carpus and metacarpus (*q. v.*). The external cuneiform alone has not been dislocated individually.

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DYSENTERY.—Gr., *δυσ*, difficult, and *εντερον*, intestine.

Definition.—An acute or chronic inflammatory disease, which usually affects

the large, but sometimes the small, intestine. The structures implicated are the solitary and more rarely the agminated nodules, and the general enteric mucous membrane. Under this name are described several different forms of intestinal flux, which in the acute stage are characterized by fever and accompanied by tormina and tenesmus.

Varieties.—Several different forms of dysentery are distinguished partly upon anatomical and partly upon clinical and etiological grounds. A division into endemic, epidemic, and sporadic has been made. It is probable that the endemic, or tropical, form owes its origin to a definite species of micro-organism, the *amœba coli*. The epidemic and sporadic varieties are of uncertain etiology. For clinical purposes a separation into catarrhal, diphtheritic, and amœbic dysentery may be made.

General Symptoms.—The first symptoms of dysentery usually set in without prodromata. A natural movement is followed by several diarrhœic stools without either pain or tenesmus. The size of the movements gradually diminish, they become admixed with mucus and blood, and are accompanied by colic, borborygmi, and tenesmus. It sometimes happens that the disease is ushered in with bloody and mucous stools, pain, and tenesmus. In light grades constitutional symptoms are scarcely present; in severe ones the disease begins with chill, fever, loss of appetite, nausea, and faintness. The evacuations remain diarrhœic and contain only mucus, when we have to deal with a mild catarrhal inflammation, or they become admixed with blood, pure bloody, pseudomembranous, or purulent, indicating more severe lesions.

The several kinds of dysentery present different stages. The epidemic and sporadic forms may be separated into catarrhal, diphtheritic, and ulcerative

stages. The endemic form, and especially the amœbic variety, appears in the ulcerative stage almost exclusively. The last also shows a greater tendency to become chronic and to relapse.

SPECIAL SYMPTOMS.—(A) *Catarrhal Dysentery.*—In this form prodromata, except dyspepsia and slight abdominal pains, are rare. Diarrhœa is the most constant initial symptom and at first it is not painful. The characteristic features of the disease—colicky and griping abdominal pain, frequent stools, and straining—are usually developed within the first thirty-six hours. The constitutional symptoms are, as a rule, insignificant; the temperature is little elevated; the pulse rarely exceeds 100; the tongue is, at first, furred and moist, but later becomes red and glazed; nausea and vomiting may be present. The abdomen may be flat and hard and the thirst excessive. There is constant desire to go to stool. The stools present the following characters: During the first twenty-four or forty-eight hours they consist of more or less clear mucus and blood, with small, scybalous masses. Under strict *regimen*, as early as the second day, they may be composed entirely of mucus and blood, and their consistence may be so viscid that the bedpan may be turned upside down in many cases without spilling the contents. The number of stools in twenty-four hours varies from 15 to 200. This condition may persist for one or two weeks, the mucus becoming gradually more opaque, of a grayish-white color, the blood progressively diminishing in quantity, and a little gray, green, or brown pultaceous *detritus*, or fluid fecal matter, appearing in the stools. As the disease subsides, fecal matter again makes its appearance, increasing in amount until

fully-formed fæces are passed, showing neither mucus nor blood. In the more prolonged cases wholly pultaceous, yellow-brown or greenish (spinach) evacuations may intervene between the bloody, mucoid stools and the passage of formed fæces. Microscopical examination of the stools shows in the first bloody, glairy discharges a predominance of red blood-corpuscles. With these are associated leucocytes and cylindrical epithelial cells in small numbers, and constantly large round or oval epithelioid cells. In later stages the stools contain fewer red corpuscles and more leucocytes; in the pultaceous material cellular elements are scarce. Bacteria are more abundant in the later stages; amœbæ are absent; occasionally the *Cercomonas intestinalis* is seen in large numbers. The duration of the disease is variable; according to Flint, the milder cases terminate in about eight days; severe ones may last as long as a month. The disease rarely becomes chronic.

Amœbic dysentery has so rarely been described in children that the diagnosis is probably never entertained by the practitioner. Within a short space of time five cases were identified and successfully treated by the author at the Johns Hopkins Hospital. The patients ranged in age from 2 to 5 years, and illustrated a moderately severe type of the disease, with the exception of one child who was very seriously sick. The clinical picture in these cases was very indefinite. The appetite and general health were good, fever and acceleration of the pulse were hardly noticeable, and the blood-examination showed only a very moderate anæmia of the secondary type. Stools varied from two to six in twenty-four hours, were rarely associated with pain, and presented nothing characteristic to the eye. They were of every degree of consistence, and might, or might not, show admixture of blood. The odor was always most offensive. Microscopically, three very typical

structures are to be found, namely: live amœbæ containing red blood-cells, Charcot-Leyden crystals, and numerous eosinophile cells. The presence of either of the latter elements should make the observer extremely suspicious of amœbic dysentery, as they occur in no other condition except helminthiasis, which can easily be excluded. The presence of the amœba is, of course, final. S. Amberg (Bull. Johns Hopkins Hosp., Dec., 1901).

(B) *Diphtheritic Dysentery*.—The primary variety presents somewhat different symptoms, depending upon the stage—whether acute or chronic—of the disease. In the *acute* stage the symptoms often from the outset are severe. There may be high fever, great prostration, abdominal pain, and frequent discharges, with tormina and tenesmus. The gripping pain and straining are the chief sources of suffering. Delirium may set in early, and the clinical features resemble severe typhoid. Osler states that he has known this mistake to be made on more than one occasion. The pulse, in the majority of cases, is but little, and sometimes not at all, accelerated. Fever, except in the severe cases, is not a prominent feature. Flint states that great frequency of the pulse denotes gravity and danger, but that the converse does not always hold good. The discharges are frequent and diarrhœal in character; blood and mucus may be found early, and sloughs may make their appearance. The presence of pseudomembranes and of necrotic portions of the intestinal coats is characteristic of the diphtheritic form of inflammation. The other ingredients are common to both the catarrhal and the diphtheritic varieties of inflammation. Upon microscopical examination the cellular elements are found to be relatively few in numbers, those most constantly present being cylindrical epithelial cells, showing more

or less fatty degeneration. Red blood-corpuscles and leucocytes are observed, especially where much blood and mucus are admixed, and large numbers of leucocytes in the purulent discharges. Fibrin also occurs, and bacteria appear in great numbers. When improvement begins feculent matter appear in the stools. The duration of the disease from the date of attack to convalescence varies from four to twenty-one days. When death takes place it usually results from asthenia. The pulse becomes weaker and accelerated, the tongue dry, the face pinched, the skin cool and covered with sweat, and the patient sinks into a drowsy condition. Consciousness may be retained until the end.

(C) *Chronic Dysentery*.—This condition usually succeeds an acute attack. Clinically the chronic forms of diphtheritic are not sharply marked off from those of amœbic dysentery. The latter disease may be subacute from the outset and fail to present an acute period. The lesions in the intestine will depend upon the origin: if amœbic, then ulceration with little tendency to healing is the rule; if diphtheritic, then pigmented cicatrices or these together with imperfectly-healed ulcers are met with. The intestinal walls are thickened and the sigmoid flexure may be palpated as a hard, resistant tube. The disease presents protean symptoms and cannot always be sharply separated from chronic diarrhoea. Its course may extend over months and even years. Many of the characteristics of the acute disease are wanting. The composition of the stools is variable; blood, necrotic tissue, and pseudomembranes are rarely found. There are periods of improvement and exacerbation; the patient loses weight and strength, becomes emaciated, suffers from periods of psychical depres-

sion, and may become bedridden. The degree of emaciation may be extreme, and a severe secondary anæmia sometimes develops. The evacuations—which vary from five to twelve or more in the twenty-four hours—take place usually without tenesmus, and with only slight colicky pains. They are fluid, of greenish-yellow or brownish-black color, now and then admixed with blood and mucus. Sometimes the stools are purulent. Indiscretions in diet are followed by an increase in the colicky pains.

(D) *Amœbic Dysentery*.—The symptoms presented are very variable. What characterizes the disease are an “irregular course marked by periods of intermission and of exacerbation of the diarrhoea, a tendency to chronicity, and the frequent occurrence of abscess of the liver” (Lafleur). For clinical purposes Lafleur groups the cases under (a) grave or gangrenous forms; (b) dysentery of moderate intensity (showing periods of intermission and of exacerbation); (c) chronic forms. Kartulis recognizes catarrhal and ulcerative stages in the diseases. The catarrhal stage, in contradistinction to epidemic dysentery, is relatively of infrequent occurrence. This stage tends to pass into the more severe or ulcerative form. In the catarrhal stage the dejections are yellow, bile-stained, and of mushy or fluid consistence. When the stools are small, then mucus, which may be blood-stained, appears. As the intensity of the symptoms increases clumps of mucus and blood are more abundant; still later the stools present a beef-water appearance, in which clear clumps, resembling frogspawn, — altered starch-grains, — float. With the advance of the ulceration they become more copious, watery, and less homogeneous; there is less blood and a great deal of shredded material appears

admixed with the mucus. Fragments of necrotic tissue from the bases of the ulcers,—small, grayish-yellow masses,—which always contain amœbæ, are present. When there is great and rapid sloughing, then the stools are greenish, grayish, or reddish brown and are still more variegated in appearance. In consistence they are watery or pultaceous and in odor penetrating and highly offensive. In the chronic form the stools are homogeneous, watery, or gruel-like; they contain few or many flakes of clear mucus, but seldom any blood or necrotic fragments of tissue.

The microscopical examination of the bloody, mucoid stools shows red blood-corpuscles, leucocytes, oval and round epithelioid cells, cylindrical epithelial cells in small numbers, crystals of ammonia-magnesian and earthy phosphates, Charcot's crystals, occasionally blood-pigment, and amœbæ. At later stages the cellular elements are less numerous, the amorphous *detritus* increased, and elastic tissue may be met with. In the liquid stools of the chronic form few formed elements except amœbæ occur. With each exacerbation there is an increase of the cellular elements.

In the grave form the stools are, at first, numerous, twenty to thirty in twenty-four hours; as the disease advances they diminish to a dozen or less, and in fatal cases, toward the end may not exceed three or four.

Abdominal pain and tenesmus are frequently present at the outset, especially in severe cases, but may be entirely absent. Vomiting and nausea are only occasionally observed. Fever is an inconstant symptom and ranges from 99° to 101° or 102°. With the development of complications (liver-abscess, etc.) it is more persistent and tends to become more regularly intermittent. The pulse,

in most instances, follows the variations in temperature. In the fatal stage of gangrenous dysentery the pulse becomes rapid,—120 to 140 or more—thready, and compressible; and at the same time the temperature tends to fall below normal. Anæmia, of greater or less severity, appears in all cases; albuminuria of slight grade is of frequent occurrence, and hyaline casts are sometimes found in the urine.

The examination of the stools for the amœbæ coli is very important and should never be omitted. Sometimes a single examination suffices to demonstrate actively-moving amœbæ. In chronic cases, however, repeated examinations may be required. In cases of liver- and of lung-abscess the diagnosis of the intestinal disorder may be established by finding the amœbæ in the aspirated contents of the former or in the sputa derived from the latter. In making the examinations for amœbæ it is advised that the stools be passed into a warm bed-pan and kept at the body-temperature during the observation. The examination should be made at once or very soon after collecting the fæces, and the most favorable parts should be chosen for the examination. A warm stage greatly facilitates the examination.

Special symptoms referable to complications are apt to arise. Those most commonly met with are in connection with liver- and lung-abscesses, peritonitis with or without perforation of the intestine, and intestinal hæmorrhage.

The duration of the disease in uncomplicated cases varies from six to twelve weeks. Recovery is tedious, relapses are frequent, and there is a constant tendency to chronicity. In uncomplicated cases recovery may be expected when the fæces become formed and amœbæ disappear from the stools.

Complications. — A local peritonitis may arise by extension, or a diffuse inflammation, which is usually fatal, may follow perforation. A local inflammation about the cæcum gives rise to perityphlitis; if about the rectum, proctitis. The regional lymphatic glands may be swelled and hyperæmic, and rarely do they undergo suppuration. A serious complication is pyelephlebitis affecting the veins of the intestine and mesentery, owing to the danger of embolic abscess of the liver. The abscesses, in these cases, may be single or multiple. Intestinal stricture is a rare sequence; amyloid degeneration of the viscera and dropsical conditions are uncommon consequences of chronic dysentery. The diseases associated with dysentery which have been noted are rheumatic swelling of the joints, malaria, typhoid fever, pleurisy, pericarditis, and endocarditis.

Case of severe dysentery complicated with infectious pseudorheumatism, arthritis, with sero-purulent effusion of the left knee, necessitating arthrotomy and drainage of the articular *cul-de-sacs*. J. Brault (Lyon Méd., Jan. 27, '95).

The sequelæ of the disease as met with in the Philippine Islands are the following: Chronicity; chronic gastritis and indigestion; obstinate constipation; paralysis (partial) of the large intestines, due either to obliteration of the glands and lack of secretion or to lack of innervation and blood-supply; anæmia from lack of assimilation of food; association of malarial fever; typhoid fever; neuritis; atrophic cirrhosis of the liver; chronic parenchymatous nephritis; abscess of the liver; metastatic abscesses of other organs, as of the lungs and kidneys; inanition; toxæmia; dilatation of the stomach and intestines. S. M. Long (N. Y. Med. Jour., Mar. 30, 1901).

Diagnosis. — The diagnosis of dysentery usually involves no great difficulty.

The characteristic evacuations are pathognomonic. The diseases from which it is to be discriminated are local affections of the rectum, such as syphilis and epithelioma, which may produce tenesmus with the passage of mucoid and bloody stools, and hæmorrhoids, and a discharging intestinal abscess, in which certain of the symptoms are simulated.

Etiology and Epidemiology. — Dysentery is one of the four great epidemic diseases of the world. In the tropics it destroys more lives than cholera, and it has been more fatal to armies than powder and shot (Osler). From the accounts furnished by history and the numerous ones supplied by physicians in the last three centuries bearing upon its epidemiology, it may be concluded that, just at present, dysentery has at all times had the widest distribution over the globe and that no considerable part has been exempted from a visitation. To quote Ayres, "of dysentery it may be said that, where man is found, there will some of its forms appear."

The present geographical distribution of dysenteric and diarrhoeal diseases is compared by Hirsch with that of the malarial diseases, with which, in respect to the manner of their endemic prevalence, the frequency of their epidemic outbreaks, and the varying severity of their type, they are in correspondence.

Like the malarial diseases, they reach the maximum of diffusion and of intensity, and more especially their greatest severity as an endemic, in equatorial latitudes; in subtropical countries there begins to be noticed a decrease in the extent and seriousness of endemic and epidemic incidence; while in still higher latitudes they almost disappear as endemic diseases and show themselves merely now and then in epidemics over an area at one time large and another

time small. In one point they differ from malarial diseases, namely: that they attain to higher latitudes of the cold zone, appearing as epidemics in regions that are quite free from malaria.

The *endemic* form of dysentery has always existed in Africa and India, but the place of its natural home is not known. Its present distribution includes Africa in its entire extent, except for a few localities. Both natives and Europeans are affected. In South Africa it prevails severely in Bechuanaland, Natal, and the Transvaal. In the north it appears in Egypt, especially along the coast and the Nile delta. In Asia it prevails to a great extent along the Arabian coast of the Red Sea as well as of the Gulf of Aden and the Persian Gulf. It exists in Syria, Asia Minor, and extends into Mesopotamia and Persia. Endemic dysentery is widely disseminated in India and the Indian Archipelago and exists in China. In Japan it assumes a milder form, while the epidemic variety is very destructive. The disease prevails in the tropical and subtropical parts of South America, but it fails to reach the wide diffusion which it presents in Africa and India. In Guiana it is found in the mountainous regions and in the tropical parts of Brazil in a severer form. In Valparaiso and La Serena in Chile the disease has a home. Foci appear in Paraguay and in the tropical provinces of Argentine Republic. In Peru it occurs along the marshy districts of the Amazon and in some of the mountainous regions, being endemic in the city of Cero de Pasco at an elevation of 13,000 feet. Venezuela does not escape; in Uruguay it is almost unknown. In Central America the disease prevails in Panama, Costa Rica, Nicaragua, Salvador, Honduras, and Guatemala. It is diffused over Mexico and appears at elevations of 6000 feet.

It assumes the severest forms in the West Indies, especially in Cuba and Hayti, and prevails to a greater or less extent in Guadeloupe, Martinique, and Barbadoes. In Europe endemic dysentery occurs over limited areas only, and is present in the more southernly-placed countries. Thus it is known in Greece, but is endemic in the Ionian Islands and the Cyclades. In Turkey it is common, in Bulgaria and Roumania, along the Donau, also, while the southern provinces of Italy and Sicily are the most severely affected regions in Europe. France, Switzerland, Belgium, the Netherlands, and Great Britain are free from endemic dysentery. In Germany there are no definite foci of occurrence, but a number of cases of the disease have been observed at Weimar and Kiel. The same facts are true of Austria, which, in general, has escaped, although cases have been reported from Prague, Graz, and Vienna.

The distribution upon this continent, and especially in the United States, of the endemic form of dysentery is, at present, difficult to estimate. If we accept this variety as synonymous with tropical and amoebic dysentery, a much closer study of the disease than yet made will be necessary in defining the limits of its prevalence. Cases have been reported from Maryland, Massachusetts, Pennsylvania, Texas, Ohio, Alabama, and Georgia. But it seems probable that many of the so-called sporadic cases occurring in this country, and, perhaps, not a few of the epidemic ones, may be shown to be of this kind. With the exception of the investigations of the disease carried out in Egypt, Germany, Austria, and Italy, the American cases above referred to have been the most thoroughly studied.

The epidemic form of dysentery is oftenest confined to a single locality, a

village or a town, with no extension to the country around. Instances are not rare in which the epidemic attacks a single detached establishment, such as a prison, a hospital, a poor-house, a soldiers' barracks, or, under certain circumstances, a ship, while there are no cases of dysentery outside these, or merely occasional cases (Hirsch). It happens much more rarely that the disease achieves a greater diffusion, and most rarely do pandemics arise. Mention has already been made of the prevalence of dysentery as an epidemic disease, especially in earlier historical times. Great epidemics have not appeared in recent years. The countries which have been most severely visited are Italy, France, Ireland, Denmark, and Norway and Sweden. In the United States, dysentery in an epidemic form, except during the War of the Rebellion, has not in late years reached serious proportions. According to Woodward, it prevails annually among the civil populations in all parts of the United States. It occurs both in the form of sporadic cases and of small local epidemics which fasten upon different districts in different years.

Sporadic dysentery, which is distinguishable both from the endemic and the epidemic forms, is of very uncertain occurrence. This variety of dysentery is attributed by Kartulis to the action of mechanical and chemical irritants upon the intestine, and arises as a secondary condition in the course of other diseases, such as acute, infectious, and chronic diseases of the heart, kidneys, and liver. By most writers the occasional cases of dysentery met with in all countries are included under this term.

Various telluric conditions have, from time to time, been supposed to influence the prevalence of dysentery. Of late years the search has been made for micro-

organisms to the action of which the disease might be attributed. With what success this line of investigation has been pursued will be stated in other parts of this article. It is a well-known fact, and one borne out by the best statistics, that both the epidemic and the endemic forms prevail especially during the hot seasons. Great diurnal variations of temperature—warm days and cold nights—have been supposed to predispose to the development of the disease, but in Egypt the facts observed are in direct opposition to this view. The degree of atmospheric moisture seems without influence: Hirsch states that, of 126 epidemics of dysentery, 65 occurred during moist weather and 61 during continued drought. The elevation and configuration of the surface seem also without particular significance, although low-lying and marshy localities are more subject to visitations than high and dry ones.

There is good reason to believe that the dissemination of the virus of dysentery takes place, in large part, through the water. And, although the same conclusive evidence of water-infection has not been brought for this disease as has been brought for cholera, yet there are many convincing observations at hand which bear out this belief. Numerous outbreaks both of the endemic and epidemic varieties, among troops and inhabitants of towns, have been traced directly to contaminated drinking-water; and the replacement of the polluted by a wholesome supply has been quickly followed by a cessation in the spread of the disease. Observations which indicated a more contagious character, a transmission from person to person, are not wanting. But whether, in these instances, the virus may not have been carried by water, wash-linen, or food is not certainly known.

The demonstration of parasitic organisms bearing an etiological relation to dysentery has been done certainly only for the endemic variety. Several different bacterial organisms have been described in association with the epidemic dysentery. The proof of their essential causal relationship with the disease has yet to be brought. The several micro-organisms will be considered with their respective diseases.

AMÆBIC DYSENTERY.—This affection is also known as endemic and tropical dysentery, and as *amæbic enteritis*. It is characterized clinically by irregular diarrhoea, a variable course often marked by periods of intermission and exacerbation, a special tendency to chronicity, and the development of liver-abscess, and anatomically by ulceration and thickening of the large intestine.

Morbid Anatomy and Etiology.—This form of dysentery has been known anatomically for more than a century: since the writings of John Hunter, who observed the disease in Jamaica. The principal contributions upon its pathology has been made by Councilman and Lafleur, Kruse and Pasquale, Kartulis, Howard and Hoover, Flexner and Harris.

The lesions in the intestine are of two kinds: (1) a general catarrhal inflammation of the large gut, which does not differ from catarrhal colitis due to other causes; (2) the specific focal lesions (ulceration) caused by the presence in the tissues of the amœba coli. The specific lesions are located oftenest in the sigmoid flexure, somewhat less often in the cæcum and ascending colon, and more rarely in the descending and transverse colon and rectum (Kartulis). The vermiform appendix may be the seat of ulceration; most rarely does the dysenteric process pass beyond the ileo-cæcal valve and attack the lower end of the ileum.

The amœbæ are present upon the surface of the intestine and in the interior of the crypts, where by continued irritation they bring about destruction of the epithelium; they may then be observed to penetrate through the interglandular tissue into the depth. They set up an active inflammation in the mucosa, shown by the hyperæmia, ecchymosis, and swelling of the glandular epithelial cells. The farther extension of the amœba takes place after the partial destruction of the muscularis mucosæ. The organisms now reach the submucosa, where the principal damage is inflicted. The number of amœbæ in the submucosa is considerable; their presence excites a reactive inflammation, and soon a solution of the tissues in which lie. Thus a cavity is formed which, sooner or later, is followed by necrosis and removal of the overlying mucous membrane. When this happens, an ulcer is the result. The lymphoid follicles are not especially attacked; they simply share the fate of the surrounding tissue. The muscular coat offers some resistance; it is not generally destroyed, but the amœbæ pass through it in certain places, enter the intermuscular tissue, and there repeat the part they play in the submucous tissue; the structures overlying the infiltration, deprived of their nourishment, undergo necrosis. The ulcers increase by this continual process of undermining; but the typical course and appearance of the ulcer may be completely changed through the action of the bacteria in the intestinal canal.

The ulcers are, for the most part, undermined. Often the defect in the mucous membrane is small and altogether inconsiderable, while the cavity in the submucosa and deeper tissues is large, and sinuous tracts, sometimes connecting

several ulcers, are met with. Again, simple ulcers, with little or no undermining of the mucous membrane and limited to the submucosa, exist. Both forms may be associated. More rarely still, large sloughs, which may consist of the mucous or muscular coats, are encountered. The part of the intestine involved becomes much thickened, partly through the infiltration present in the submucous and other coats, and partly in virtue of a thickening of the peritoneal coat; adhesions between adjacent intestinal loops and deformation also occur. According to Councilman, fibrinous exudation upon the surface of the mucous membrane (diphtheritic or croupous membrane) does not take place in uncomplicated cases, while Kartulis describes its occurrence.

The amœbæ occur in greater or less numbers in intimate association with the ulcers and even in adjacent parts. They are found in the tissue-spaces, within the crypts of Lieberkuhn, in definite lymphatic vessels, and in the veins.

The mere presence of amœbæ in the stools is not sufficient evidence of the existence of amœbic dysentery. As early as 1870 Lewis and Cunningham found amœbæ in the stools of persons sick of cholera in India. They have even been found in the stools of healthy persons (Grassi, Kruse and Pasquale, Mincke and Roos, Schuberg). Losch (in 1875) gave the first accurate account of the organism which he found in the stools of a dysenteric patient, and he studied the intestine removed at the autopsy. R. Koch observed amœbæ in sections of the intestine of a number of cases of dysentery occurring in Egypt and India, and suggested a causal relationship between them. Soon afterward (1885) Kartulis was able to find them in more than five hundred cases of endemic dysentery prevailing

in Egypt, while they were absent in other diseases. Similar organisms were also found in the contents or walls of amœbic abscess of the liver. The results of Kartulis's studies have been abundantly confirmed in this country by Osler, Councilman, Lafleur, Simon, Dock, Eichberg, Howard, Musser, Stengel, Flexner, Wilson, Harris, and others.

The amœbæ coli (s. dysenteriae) resembles in many ways the amœbæ occurring in the stools of healthy beings. The average size of the latter is from 12 to 36 microns, of the former from 10 to 50 microns. The structure of the two forms is also similar. In a state of rest they appear as slightly-refractive and faintly-granular spheres; in the active state a separation into structureless ectoplasm or hyaloplasm and a more refractive, granular, endoplasm or granuloplasm takes place. The pseudopodia are extruded slowly and may be easily observed; change of position does not always follow the extrusion. Nuclei are present and often visible, even in the fresh state. This description suffices for the non-dysenteric as well as for the dysenteric varieties; in the latter there is found, in addition, contained within the endoplasm, vacuoles, bacteria, and red blood-corpuscles. The chief constituent, from a diagnostic stand-point, is blood-corpuscles, as these never occur in the amœbæ found in healthy persons; both the vacuoles and bacteria may, however, be present. Nothing definite is known of the mode of propagation, but it is believed that multiplication takes place by division.

The amœbæ are very little resistant; the stools, etc., must, therefore, be examined soon after their evacuation. Their number quickly diminishes in material outside the body, and at the end of from six to twenty-four hours they

are often no longer to be found. They have not been certainly successfully cultivated outside the body in a pure state, although they may have been cultivated along with other micro-organisms (Kartulis, Celli, and Fiocco).

The evidences for the belief in the causal relationship between the amœba coli and endemic dysentery is summed up by Kartulis as follows: "The constant presence of the organism in cases of endemic dysentery (with the exception of the so-called 'Cochin-China diarrhœa'; see below); its presence in the walls of the dysenteric ulcers and absence from other kinds of intestinal ulcers; the successful production of dysentery in cats by the injection of fœces containing amœbæ into the rectum and even of pus from liver-abscesses free from other micro-organisms; the negative results of similar injections (excepting in the experiments of Celli and Fiocco) of other micro-organisms obtained from dysenteric stools; and, finally, the failure of healthy stools containing amœbæ to provoke dysenteric lesions in cats."

[The recognition of the amœbæ in sections of hardened tissues and their distinction from swelled and degenerated tissue-cells are not always easy. Mal'ory has introduced a special staining method in which thionin is used, and Harris employs toluidin-blue, in order to differentiate these organisms from other cells. SIMON FLEXNER.]

The endemic dysentery of warm climates is probably generated by animal parasites, is not contagious, and is sometimes also found in temperate regions. The amœba seems to be the principal factor in its causation, and the pathological changes produced are most likely due, in part at least, to the bacteria developed *in situ* or transported there by the wandering amœbæ. The direct pathogenic action of these corpuscles has not yet been satisfactorily established.

Wesener (Rivista Inter. d'Igiene, Sept., Oct., '92).

There are three forms of the organism: (1) the *Amœba coli felis* (Losch), which is the true amœba of dysentery; (2) the *Amœba coli mitis*, the cause of the diarrhœa in the second case; and (3) the *Amœba coli vulgaris*, the form observed in healthy persons. Calomel in small doses appeared to be the best method of reducing the number of amœbæ in the stools. Quincke and Roos (Berliner klin. Woch., No. 45, '93).

The amœba dysentericæ is distinct from the non-infectious form, or amœba coli. The former, when coupled with bacteria, is the cause of dysentery and of some liver-abscesses. There still remain other liver-abscesses which must be classed as idiopathic, and in which climatic conditions must be looked on as playing a large part. Among the many questions which are yet to be solved concerning the amœbæ are the following: Whether their virulence is constant or can be lost and acquired; how they gain access to the human body; how the bacteria aid them; where the bacteria come from; how the dysenteric ulcers begin; whether the predisposing causes of cold and indigestion work on the human organism or on the bacteria; whether there is not also a systemic infection, as well as a local process; in what way the amœbæ gain access to the liver, whether along the portal system, the lymphatics, the peritoneum, or the bile-passages. There are certain cases which point to each mode, but in multiple abscesses the propagation is along the blood-current, either from the ulcers or backward from an original single focus. Kruse and Pasquale (Zeit. f. Hygiene u. Infectiouskr., Feb. 8, '94).

Chronic-dysentery amœbæ are not pathogenic to cats except when the intestinal mucous membrane has been injured, as by a sublimate solution. The amœbæ are not the cause of dysentery, but irritants which prevent the healing process in lesions already existing. Kovac (Zeit. f. Heilkunde, B. 13, H. 6, '94).

Biological and clinical study of 235 cases of diarrhœa and dysentery. The

amœba found 86 times, most frequently in cases of typical diarrhœa, less often in simple catarrhal enteritis, and least frequently in sporadic dysentery, whether mild or fatal. The pathogenic importance of the amœba denied, experiments upon cats having shown that the amœba swallowed up numerous microbes, and that, where amœbæ were numerous, but a small number of microbes were met with. Opinion expressed that the amœba prevents the development of bacteria and permits healing of the lesions, thus explaining the vegetating form of the ulcerations observed by Councilman and Lafleur. The amœba prevents an acute evolution of the process, which, in turn, explains why amœbic dysentery is of a chronic type, as assumed by many authors. Cassagrande and Barbaglio-Rapisardi (Gaz. degli Osp., No. 66, '95).

Cats injected with portions of the stools showed only a mild follicular enteritis. Small portions of a dysenteric stool were mixed with peptone solution, and of two cats injected at the same time with the same stool, one remained living, while the other died after six days. There were practically no differences in their bowel changes from those seen in uninjected cats. The fifth and sixth cats injected remained living; so that the results were not characteristic. In no case were amœbæ obtained by culture, or seen upon microscopical examination. A streptococcus that was obtained, and which grew in the form of a streptobacillus, reacted to a dilution of 1 to 100 of blood-serum from the patients with dysentery, but it reacted in just as high a dilution with the blood from patients who had no dysentery. No description could cover, in a broad sense, the forms that one is likely to meet in the contents of the intestines. Ascher (Deut. med. Woch., Jan. 26, '99).

Conclusions concerning the parasitology of tropical dysentery: 1. No bacterial species yet described as the cause of dysentery has an especial claim to be regarded as the chief micro-organism concerned in the causation of the disease. 2. It is unlikely that any bacterial species that is constantly and normally present in the intestine or in the en-

virons of man, except where the disease prevails in an endemic form, can be regarded as the probable cause of epidemic dysentery. 3. The relations of sporadic to epidemic dysentery are so remote that it is improbable that the two diseases are produced by the same organic cause. 4. The pathogenic action of amœba coli in many cases of tropical, and in certain examples of sporadic, dysentery has not been disproved by the discovery of amœbæ in the normal intestine and in diseases other than dysentery. While amœbæ are commonly present and are concerned in the production of the lesions in subacute and chronic dysentery, they have not, thus far, been shown to be equally connected with the acute dysenteries even in the tropics. In the former varieties bacterial association probably has much influence upon the pathogenic powers of the amœbæ. Simon Flexner (Phila. Med. Jour., Sept. 1, 1900).

Six cases of the ordinary type of so-called amœbic dysentery, in which the blood did not react with Shiga's bacillus. This tends to indicate distinctly that the disease is separate and distinct from the dysentery as met with in the tropics. William Osler (Jour. Amer. Med. Assoc., Jan. 5, 1901).

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The most frequent complication of dysentery in the Philippine Islands is malaria. A malarial spleen and active malarial parasites were found in 4 out of 66 cases of chronic amœbic dysentery which came to autopsy, and once in 12 cases of subacute (non-amœbic) dysentery. In 157 cases of chronic and subacute dysentery among soldiers sick in the First Reserve Hospital, Manila, in which blood examinations were made, the malarial parasites were found in 36, or in nearly 23 per cent. J. J. Curry (*Boston Med. and Surg. Jour.*, Feb. 21, 1901).

When the first case of amœbic dysentery was found in Johns Hopkins, very careful inquiries were made as to the patient's possible connection with things tropical. Now, however, that many cases have been seen there is no question that the disease may occur in those who have never been outside of Baltimore. The disease has been observed especially in children and others who have taken gutter-water or who have had their hands covered with material from the gutters when eating. It would seem, then, that the frequent amœbæ seen in such water have some connection with the pathogenic amœbæ. MacRae (*Proceedings Amer. Med. Assoc.*; *Medical News*, June 14, 1902).

Complications.—Involvement of the peritoneum in the chronic cases with deformation of the intestine has already been mentioned; through the formation of adhesions definite kinking of the bowel may result. Perforation of the bowel, leading to peritonitis, is a relatively-rare complication, and peritonitis without previous perforation apparently still rarer. Small hæmorrhages in the intestinal mucosa, in the region of the ulcers, are frequent, but large hæmor-

rhages seem uncommon. In one of Councilman and Lafleur's cases about one hundred and twenty-five cubic centimetres of clotted blood were passed per rectum on the last day of illness. By far the most important complications are abscess of the liver and of the liver and lung. A very important, but unusual, sequel of liver-abscess is perforation of the inferior vena cava. Flexner has described two such cases. Although the data at hand for computing the frequency of amœbic abscess of the liver in endemic dysentery are, as yet, too few to admit of definite conclusions, yet, according to Kartulis (based on observation of 500 cases of liver-abscess), 55 to 60 per cent. were of dysenteric origin; Councilman and Lafleur found liver-abscess 6 times in 15 cases, Kruse and Pasquale 6 times in 57 cases of amœbic dysentery. Kartulis states that liver-abscess, which is so common a complication of endemic dysentery, is infrequent in the epidemic form. Hence the statistics of British and French physicians covering this subject, in which the proportion of 1 case of liver-abscess for every 4 or 5 of dysentery occurring in the East, probably relate chiefly to the amœbic form.

Hepato-pulmonary abscess occurred four times in Councilman and Lafleur's cases. Following pulmonary abscess, pleurisy and pyothorax or pyopneumothorax (Flexner) may supervene. The amœbæ were found in the contents of the hepatic and pulmonary abscesses and pyothorax. In abscess of the lung the organism appears in the sputa. Kartulis has encountered abscess of the brain and spleen in amœbic dysentery; in neither situation was he able to demonstrate amœbæ.

The question of the existence of amœbic hepatic abscess without evidence of previous intestinal lesions is still an

open one. Kruse and Pasquale mention two cases, but admit that they are not conclusive. Flexner has described an undoubted case. The etiology of the so-called idiopathic, or tropical, liver-abscess is still wrapped in obscurity.

Results of examination in a case of abscess of the liver following dysentery in which the amœba was found in the pus drained from the abscess. The amœbæ from the abscess were somewhat larger than those described by Kartulis; they were circular, sometimes ovoid, but while in movement had an irregular outline. The alterations in contour and change in locality were as remarkable as in some forms of pond amœbæ. Motion continued active for hours; in two instances for ten hours. In the stools the amœbæ were rare in the brownish liquid; more frequent in the small sloughs passed. In form and other characters they were like the organisms in the pus from the liver-abscess. Osler (Johns Hopkins Hosp. Bull., vol. i, No. 5).

Statistics showing that suppurative hepatitis is almost always the consequence of dysentery; there is but a single pathogenic element concerned in the production of both diseases. Proof: if dysenteric fæces containing living amœbæ be injected into the rectum of cats typical dysentery will be produced, the animals dying usually in from thirty-nine hours to nine days, though some may survive and even recover; 7 out of 11 of those injected showed amœbæ in the evacuations. The classical alterations of dysentery were found at autopsy. Zancarol (Le Progrès Méd., June 15, '95).

Dysentery in the Philippines has been of such a character as to make the following facts worth noting: 1. Dysentery, as it is seen here, is not a single, but consists of two distinct and separate diseases. 2. Acute dysentery does not produce abscess of the liver, nor does it produce ulceration of the colon. 3. Its fatal result is due to inflammation of the bowel, rapid elimination of the watery fluids of the body, toxæmia and exhaustion, much after the manner of cholera, though requiring four, six, and

twelve days before its termination or crisis. 4. Amœbic dysentery differs from acute dysentery anatomically, pathologically, and etiologically. The only similarity between them is: the colon is the *locus minoris resistentiæ* for both the bacillus of Shiga and the amœba. Here all similarity ends. The bacillus of Shiga leaves no other lesion behind, save its effect upon the mucous membrane of the colon and enlargement of the adjacent glands. The amœba of dysentery invades the three layers of the colon, producing pinched-out ulcers, or ulcers with undermined edges. It also passes to the liver and produces characteristic lesions. There are two varieties of the amœba which differ in no respect save as to size. The pathogenic variety is somewhat larger than the non-pathogenic. These two varieties of the amœba have been the cause of all the confusion regarding the amœba as an etiological factor in amœbic dysentery. Finally, in regard to the dysenteries produced by the Shiga bacillus and amœba: (1) the duality of dysentery is proved; (2) acute dysentery is the result of infection with the bacillus of Shiga; (3) it is infectious in the same way as the bacillus of typhoid fever is infectious; (4) amœbic dysentery is caused by an amœba; (5) there are both a pathogenic and a non-pathogenic amœba, which fact has produced much confusion regarding the amœba as an etiological factor; (6) the lesions of amœbic dysentery differ from those produced by the bacillus of Shiga; (7) the therapeutic agents generally used for the treatment of acute dysentery are in no way curative; (8) magnesium sulphate should be included in this list; (9) quinine solution is a specific for the amœbic dysentery, but its employment in rapid, acute, ulcerating cases is fraught with danger, and from the nature of the lesions it cannot be retained for a sufficient length of time to produce beneficial effects. M. H. Bowman (Phila. Med. Jour., from N. Y. Med. Jour., Aug. 17, 1901).

COCHIN-CHINA DIARRHŒA. — This is a form of dysentery which occurs in

Cochin-China and some other tropical countries. Normand in 1876 found, in the stools of soldiers who returned from Cochin-China to Toulon and who were suffering from chronic diarrhoea, two forms of nematodes (*Anguillula stercoralis* and *Anguillula intestinalis*) afterward shown by Leuckhart to be the successive generations of a single species to which he gave the name *Rhabdonema strongyloides*. Further studies have rendered doubtful its etiological relation to the disease. The parasite is often absent at the beginning of the affection, while it is not infrequently found in the stools of healthy persons. Calmette has studied more recently this form of enterocolitis, and has made it probable that the bacillus pyocyaneus, alone or in association with the streptococcus, is the cause of many cases. He also demonstrated the bacillus pyocyaneus in the drinking-water at Saigon and Gokong. Calmette was able to produce hæmorrhages and ulceration of the stomach and intestine in rabbits by injection of cultures of the bacillus pyocyaneus. L. F. Barker has reported several cases, from the Johns Hopkins Hospital, of enteric infection and inflammation caused by this bacillus. In one instance an extensive diphtheritic inflammation of the œsophagus, stomach, and intestine existed. As a cause of diarrhoea and dysentery in infants it has been met with by Adami and Williams in Canada, and of an epidemic of the same diseases in Albany, N. Y., by Blumer and Lartigan.

In the case of Europeans, a large number of species of micro-organisms found, among which are the colon bacillus and an amœba. In natives (Cochin-Chinese) the number of species is less numerous, probably as a result of the more simple and almost entirely vegetable diet. Two species regarded as important found: a coccus having all the properties of the streptococcus-erysipilatous and the bacil-

lus pyocyaneus. A. Calmette (Archives de Méd. Navale, Sept., '93).

The combination of the colon bacillus and the proteus bacillus is the essential cause. In northern Europe the epidemic is decidedly different from those seen in tropical climates. Chaltin (Archives Méd. Belges, Apr., '94).

CATARRHAL DYSENTERY. — This is a disease of the intestines, affecting principally the large bowel, which occurs sporadically or epidemically. It is the form of dysentery met with most frequently in temperate climates.

Morbid Anatomy and Etiology. — The area of intestine involved may be large or small; sometimes the affection is limited to a circumscribed area or areas, at others the mucosa in its entire extent is involved, even including the stomach. The colon is most often the seat of the lesions. Woodward questioned the existence of an isolated affection of the small intestine, while Nothnagel claims to have met with cases in which the pathological process stopped abruptly at the ileo-cæcal valve, the large gut having entirely escaped. The general mucosa and the solitary lymphoid nodules, especially, are affected. In the acute stage the affected part of the mucous membrane is reddened, especially about the lymphoid nodules and plaques, and small extravasations of blood may appear. There is an excessive production of mucus and a rich desquamation of epithelial cells. The villi and solitary nodules are swelled, the latter becoming unduly prominent. The microscopical picture agrees with the macroscopical appearances: there is hyperæmia, swelling, and desquamation of epithelial elements and round-celled infiltrations of the mucosa. The swelled lymphoid nodules show an increase in cells, the chief ones being of the large epithelioid variety occupying the germinal centres. Extravasations of

blood are present in the mucosa about the nodules. The submucosa shows changes only in the severest grades. In more protracted cases ulceration, limited to the nodules or extending into the adjacent mucosa, appear. The chronic cases are characterized by pallor of the general mucous membrane; pigmented spots appear, and at one time the mucous membrane is atrophic, at another hypertrophic. In the latter instance, in the most marked cases, a polypoid condition of the affected mucous membrane may exist.

The causes of this disease are twofold, namely: agents of (A) intoxication and of (B) infection. (A) All caustic chemical agents which act directly upon the mucous membrane (acids, alkalies, etc.) and others brought by the blood and eliminated by the intestine (mercury, ricin, etc.) and the more indefinite chemical substances which are found, under some circumstances, in the ingested food. (B) Bacteria play an important rôle in the causation of this disease. Booker's study of the summer diarrhoeas of children is most convincing in this respect. "No single micro-organism is found to be the specific exciter of the summer diarrhoea of infants, but the affection is generally to be attributed to the result of the activity of a number of varieties of bacteria, some of which belong to well-known species and are of ordinary occurrence and wide distribution, the most important being the streptococcus and proteus vulgaris." As to the mode of entrance into the mucosa, Booker says: "In the superficial epithelium of the intestine is apparently to be found the chief protection of the mucosa against the invasion of bacteria. When the epithelium is preserved, bacteria are not found in the mucosa beneath, whereas they may be seen entering it in

places where the epithelium has been lost or injured." Gärtner's bacillus enteriditis is capable of provoking acute enteritis; and acute enterocolitis is associated as a secondary affection, with a variety of specific infections (cholera, typhoid fever, tuberculosis), intestinal diseases, and other infectious processes (sepsis, influenza, pneumonia, scarlet fever, measles, diphtheria, etc.).

Seven cases of endemic dysentery in which a large aërobic bacillus was isolated. It developed well on ordinary culture-media, liquefying gelatin, curdling milk, and producing gas. It is motile, somewhat like anthrax morphologically, but is decolorized by Gram's method. Inoculated into animals, it produces a hæmorrhagic septicæmia with ulceration of the colon. Roger (Comp. Rend. de Biol., ser. xi, 1, '99).

The specific cause is an organism much like the bacillus coli, and which is agglutinated by the blood of dysenteric patients. An antitoxic serum prepared with which 266 cases were treated, with a death-rate of 12 per cent., the death-rate during the same period under ordinary treatment in 1736 cases being 34 per cent. Shiga (Report by Surgeon Eldridge to the U. S. Marine-Hosp. Service, 1900).

In Fiji dysentery is endemic and most prevalent in May, June, and July: the season of dry weather and scanty water-supply. While under some circumstances the mortality is high,—40 per cent.,—the average death-rate is 7 per cent. C. W. Hirsch (Edinburgh Med. Jour., Jan., 1900).

Among 277,000 cases of malarial disease recorded by various writers, 3054 were registered as pernicious fever, and, of the 1317 of those which were more definitely classified, only 8 were considered to be as belonging to the pernicious dysenteric class. Kanallis and Cardamatis (Progrès Méd., May 19, 1900).

In Manila dysentery is very common. Investigation has conclusively shown the two types of dysentery: one dependent upon a specific bacillus said to resemble the bacillus typhosus or the bacillus

coli communis, the other being the ordinary amoebic dysentery of the tropics. R. P. Strong and W. E. Musgrave (Jour. Amer. Med. Assoc., Aug. 25, 1900).

Analysis of the waters of Landerneau (Brittany) in the midst of an affected region. The nutritive gelatin plates of Ellsner showed colonies of the colon bacillus, the method of Péré also. The bacillus resembled Eberth's bacillus, but was distinguished by the lactose test, which differed from the reaction with Eberth's bacillus. F. Lenoble (La Presse Méd., Oct. 27, 1900).

Comparative study of several cultures of bacilli obtained from cases of dysentery. These organisms were designated Manila cultures, Kruse's bacillus, Shiga's bacillus, cultures of a Porto Rican, and Strong's bacillus. The differences of growth are slight, and probably depend upon purely accidental circumstances. A comparison of the morphology of the bacilli shows only very minor differences. Kruse has not observed motility at any time in his culture; Shiga states his to have been feebly motile, while those of the author were at first slightly motile, but soon became quiescent in artificial cultivation and did not regain motility. Strong's observations coincide with the author's. Vedder and Duval, under the direction of the author, have succeeded in demonstrating flagella by Van Ennengheim's method in several cultures. The serum reactions have been of the greatest importance, and are, moreover, unmistakable in significance; they indicate close relationship between the bacilli from Japan, Manila, Porto Rico, and Germany, and they further render probable the identity of the epidemic dysentery of this country with that of the East and Germany. Flexner (Brit. Med. Jour., Sept. 21, 1901).

Shiga's bacillus dysenteriae is found in the latter half of the first week of the disease in the fresh stools; in the later stages of the disease it is rather difficult to cultivate. It disappears more or less completely as the patient improves. If there is a relapse it again appears in large numbers. One finds the bacilli in almost pure culture in fresh catarrhal

or diphtheritic areas in the bowel; in fresh conditions they are found more superficially in the lesions; in the old infection, the colon bacillus and other micro-organisms overgrow them. The bacilli are often found in the mesenteric glands, but the author has never found them in the liver or spleen. He examined five cases of parotitis which occurred in the course of dysentery, and was unable to find the bacilli in extirpated portions of the glands or in juices of the gland. The urine, blood, and milk are always sterile. Because of the localized character of the disease one finds in dysentery no tumor of the spleen, no eruption, and no inflammatory conditions of the bone and bone-marrow, etc., such as are found in typhoid fever. The agglutinative reaction he has tested in hundreds of patients and found it generally parallel in intensity with the severity of the disease. It appears in some instances in dilution as great as 1 to 130, and so on down, very mild cases being negative at 1 to 10. He has seen the reaction present as long as eight months after the attack. It is now, however, of importance in diagnosis in many instances, because it is very likely to be absent in very mild or doubtful cases. He discusses the relation between the typhoid serum reaction and the prognosis, and then states that, after making quantitative investigations on the agglutinating power of the blood in dysentery, he found that its intensity is practically parallel with the severity of the disease excepting in very grave cases, which are commonly fatal, in which the reaction is usually but slightly marked. Agglutination appears only in the second or third week of the disease, and reaches its highest point in convalescence. It sometimes appears as late as the sixth week, and this late appearance makes it of little importance in diagnosis. The bacteriological diagnosis of a case of dysentery may be made by carrying out the agglutination test of a culture with immune serum, by cultivating on glucose agar, and in milk. If agglutination occurs at once, if there is no gas-production, and if milk has

not coagulated, the dysentery bacilli may be considered to be present. K. Shiga (Deutsche med. Wochen., Oct. 24, 1901).

Dysentery is due to the increase in the virulence of micro-organisms that ordinarily inhabit the intestine. The writer does not consider it due to a specific organism. Bertrand (Revue de Méd., July 10, 1902).

DIPHTHERITIC DYSENTERY.—An inflammatory disease of variable and uncertain etiology, which affects especially the large intestine, sometimes involving the small gut, which may or may not be attended with fever; is characterized by mucous, serous, or bloody stools, and is accompanied with tormina and tenesmus. The anatomical lesions consist of necrosis of the mucous membrane, the deposit within its substance and upon its surface of a fibrinous pseudomembrane, and the formation of ulcers. This occurs (*a*) as a primary disease, in which form it probably gives rise to the great majority of the cases of epidemic dysentery; (*b*) as a secondary and terminal affection in many acute and chronic diseases, the chief ones being acute general infections and chronic renal, cardiac, and hepatic disease. Certain cases of *sporadic dysentery*, the result of the action of chemicals and metastatic bacteria upon the intestinal mucous membrane and indirectly of mechanical irritants (coprostasis, intestinal worms), belong to this class.

Morbid Anatomy and Etiology.—The pathological process begins with hyperæmia and swelling of the submucosa and mucosa. The unique character of the disease begins with the appearance of small grayish-white membranous patches upon the surface of the mucous membrane. These increase in size and become confluent. At first they are readily removed with the finger; at a later stage they are more adherent. They tend to appear,

by preference, upon the more prominent and projecting parts of the mucosa; thus, in the small intestine along the tips of the valvulæ conniventes; in the large, corresponding with the insertion of the longitudinal muscular bands. At a later time and in severe cases the intervening mucous membrane may become covered. Upon microscopical examination, in the earliest stages of the disease the blood-vessels of the submucous and mucous coats are congested and contain an increased number of polymorphonuclear leucocytes; the superficial epithelial layer is necrotic, and fibrin and leucocytes are present on the injured surface. Somewhat later the necrosis has extended and involved the deeper parts—glands and interglandular tissue—and the fibrinous membrane is thicker and intimately bound up with the necrotic tissue. Many kinds of bacteria are present in the necrotic and exudative material. The swelling of the submucosa may reach a high degree, due to œdema, cellular infiltration, and a deposit of fibrin. The blood-vessels of the mucous membrane become plugged by hyaline thrombi. The separation of the dead tissue leaves an ulcer behind. The young ulcers do not extend deeper than the submucosa coat; later, and by continued destruction, the muscular coat may be exposed. Perforation of the intestines is, in this form of dysentery, unusual. Ecchymoses occur in the neighboring mucosa. Even the deepest ulcer may, through the formation of granulation-tissue, heal. In these cases the wall of the intestine becomes thickened; the muscle hypertrophic; the scars have a pigmented appearance, and, through retraction of the cicatricial tissue, deformity and often stenosis of the bowel arise.

The points of predilection of the path-

ological process are the flexures (sigmoid, splenic, hepatic), the ascending colon, and cæcum. In the Crimean War the rectum, sigmoid flexure, and descending colon were the principal points of attack. The small intestine is only rarely affected in its lowest parts, and this in severe cases; in certain secondary forms of dysentery it may be attacked alone.

Klebs was the first to describe short bacilli in the crypts of Lieberkuhn in diphtheritic dysentery. Since this time a large number of bacteria have been described in association with the disease. None of these appear to be specific, and the circumstances of the disease make it easy to isolate different bacterial forms. From what has already been said it is not probable that diphtheritic dysentery is caused by a single micro-organism. As regards the question of etiology of epidemics, whether in a given epidemic a single species of micro-organism is to be regarded as the cause, and in different and widely-removed ones the same species will be found, cannot be answered at present. Thus far a very small number of epidemics have been studied with modern bacteriological methods.

Ziegler described small bacilli in the crypts of Lieberkuhn and the underlying mucous membrane. Marfan and Lion cultivated from the mesenteric glands, pericardial fluid, and heart's blood of two cases the bacillus coli communis. Babès has cultivated the streptococcus, proteus vulgaris, and other organisms from dysenteric cases. Maggiori studied, in 1891, an epidemic which occurred in Italy. He found in the mucous stools of all cases the bacillus coli communis, in association with proteus vulgaris. More rarely pyococci, bacillus fluorescens, and pyocyaneus were obtained. Ogata investigated an epidemic which prevailed in Japan. He found small ba-

cilli, which lay in the protoplasm of cells; they were present in the base of the ulcers. Cultures from fifteen cases gave a short, non-pathogenic, liquefying bacillus. From eleven cases Ogata cultivated a bacillus which also liquefied gelatin, but was pathogenic. Guinea-pigs, inoculated subcutaneously, develop hæmorrhages and ulcers in the intestine. Rectal injections produced more pronounced results. Condorelli, Maugieri and Aradas describe a bacillus which they obtained from an epidemic and also isolated from the drinking-water; Bertrand and Baucher studied an epidemic at Cherbourg and isolated several different bacteria, none of which appear to be specific. Silvestri described diplococci which caused diarrhœa in dogs. Colli and Ficocco found that in the dejections of dysenteric persons the bacillus coli communis is always present; with it is often associated a typhoid-like bacillus; more rarely the streptococcus and proteus bacillus. The introduction of this bacillus coli, either alone or in association with the other bacteria, by means of the mouth or rectum, into cats, gives rise to dysentery. According to these writers, the association of the bacillus coli communis with the other bacteria mentioned leads to its conversion into the bacillus coli dysenterie. Celli has more recently expressed the idea that the primary injury to the intestine is produced by the toxin of the bacillus dysenterie, which is followed by the injurious action of pyogenic cocci contained within the intestine. Ciechanowski and Norrak have failed to confirm this view by experiments, although they found large numbers of streptococci in the stools of cases of sporadic dysentery. The bacillus pyocyaneus, according to Blumer and Lartigan, may be associated with epidemics of dysentery in this country.

Treatment.—The hygienic rules which are observed in the prevention of other infectious diseases and especially of cholera have been employed with excellent effect in controlling epidemics of dysentery. The employment of filtered and boiled water has reduced the numbers of cases and the spread of the disease in the tropics. The same principles are applicable to the treatment of articles of food (vegetables, fruits, etc.) which come into contact with water. Other prophylactic measures consist in the use of suitable clothing which obviates the injurious influence of rapid changes in temperature and humidity of the air and the proper disposition of the dejecta from the sick.

In armies in the field intemperance and all forms of excess should be severely repressed. For the purification of water every available method should be used, but the most practical and certain is boiling. Soldiers willingly adopt these precautions if tea or coffee is served out to them for use with the water. As the sanitary service is not adequate to cope with the necessary work of disinfecting hospitals and the sanitation of battlefields, there should be organized in time of peace a special service for those purposes which should be in a condition to set to work from the very beginning of mobilization. A service of this kind was tried with success by the Russians in 1877. Antony (Thirteenth Inter. Med. Congress; *Brit. Med. Jour.*, Sept. 8, 1900).

The direct treatment is, in part, dietetic, in part therapeutic. In acute cases the diet is to be restricted to milk, whey, and broths, and during convalescence great care is to be exercised in providing only the most digestible articles of food. In the use of a diet of milk, which often will be the chief article, the appearance of curds in the stools is the indication to dilute or partially peptonize the milk before it is administered. Di-

luted egg-albumin may supplement milk or even take its place for a few days if there is much intolerance to the latter. Sometimes milk is made more acceptable by dilution with lime or Vichy water. The quantity of milk, for an adult, administered in twenty-four hours should be from 2 to 2½ quarts. Whatever the food, it is advisable to give it in small quantities and at frequent intervals.

The patient even in chronic cases should be confined to bed; in acute cases no especial persuasion will be required. For the relief of the abdominal pain, the external application of fomentations or turpentine stupes will sometimes suffice; but the internal use of opiates may be demanded. When the pain is low down in the bowel then enemata of opium or suppositories containing some form of this drug or of cocaine may be resorted to.

When a case is seen early, especially if there has been constipation, a purge should be administered. This can be either castor-oil or, what is preferable, a saline. By this means the faecal contents of the large intestine, which tend to pass continuously over the inflamed area, should be effectually removed. The saline selected should be given in sufficient doses to promptly produce abundant dejections, and it is then to be discontinued. There may be a marked diminution in the frequency of the dysenteric evacuations, and great relief of the tormina and tenesmus following the operations of the purgative. The use of a saline is contra-indicated by feebleness of the patient; in such cases castor-oil is to be preferred.

Ninety-five cases treated at Hyderabad, India, by sulphate-of-magnesium method. The number of days under this treatment before the dysenteric symptoms disappeared was never more than 5,

and in many cases 1 or 2 only. Leahy (Lancet, Oct. 4, '90).

[Saturated solutions of magnesium sulphate urged by many observers: To an ounce of saturated solution of magnesium sulphate 10 drops of dilute sulphuric acid are added; this is given every hour or two until it operates freely and the stools have become feculent, free from blood and mucus, and the pain and tenesmus are relieved. W. W. JOHNSTON, Assoc. Ed., Annual, '91.]

Mortality reduced from 5 to 10 per cent. to practically *nil*, by avoiding all irritants and stimulants; rendering the intestinal canal aseptic by preventing the decomposition of contents; by counteracting acidity of the blood by alkalies and thus quieting the abnormal action of the intestinal glands. Diet restricted to arrowroot-milk and trinitrate of bismuth, Dover's powder, and soda internally. Bahadurji (Brit. Med. Jour., Oct. 24, '91).

Drachm-doses of a saturated solution of Epsom salts, in combination with 10 minims of dilute sulphuric acid, every hour, are strikingly effective. V. G. Thorpe (Brit. Med. Jour., Feb. 26, '98).

Sulphate of soda or sulphate of magnesia may be given in drachm doses every quarter- to half- hour for the first four or six doses, and afterward at longer intervals until the motions assume a good yellow color. With the saline a little quinine and perchloride of mercury may be combined if desired. Series of 555 consecutive cases treated in this way, with only 6 deaths. For chronic or relapsing cases the saline treatment is not nearly so efficacious, and, after one or two doses of the salt, castor-oil, bismuth, etc., should be given. Buchanan (Brit. Med. Jour., i, p. 306, 1900).

Salines used in 855 cases in Bengal. There were only 9 deaths: a mortality of only a little over 1 per cent. The following mixture was used:—

R Sodii sulphatis, 1 drachm.

Aquæ fœniculi, ad 1 ounce.

This was given four, six, or eight times a day (each dose represented 1 drachm of the saline) as the case required. No dose was repeated on the

following day till the stool had been inspected. The saline was continued till every trace of blood and mucus had disappeared completely in two or three days; in others they returned on the third or fourth day, necessitating a repetition of the saline.

The saline treatment is advocated for acute cases only. It is not considered a safe method for chronic or relapsing cases with ulceration of the colon. In cases in which either the symptoms or the history point to the disease being either chronic or relapsing, the saline was used for one or two doses during an exacerbation of the chronic state, and then the case was treated with soda and bismuth or with salol, with an occasional dose of castor-oil. For stools containing scybala nothing is so good as a dose of castor-oil guarded by 10 minims of laudanum.

When the patient can be admitted to hospital, the saline is the best method of treating acute dysentery, but it should not be applied in a routine fashion in out-patient practice, on account of the possibility of many patients having had previous attacks, and having their bowels in a state of unhealed ulceration. The success which has this year attended the treatment of the chronic cases in due to careful dieting on rice-water (mar), and boiled milk and tyre (dahi), the use of anthelmintics (a large proportion of the inhabitants of this part of Bengal harbor both round and tape- worms), and the careful occasional use of the saline, with Dover's powder and the intestinal antiseptics. W. J. Buchanan (Brit. Med. Jour., Apr. 13, 1901).

Among the drugs used to combat the disease, ipecacuanha still maintains its reputation in the tropics. It is usually administered after a preliminary dose of laudanum or morphine, which is followed in half an hour by from 20 to 60 grains of ipecacuanha. Should the dose be rejected, it is repeated in a few hours. This mode of treatment was not satisfactory during the War of the Rebellion, and Osler has failed to see in sporadic cases

the marked effects claimed for it by the physicians in the tropics.

Epidemic of dysentery in Alquizar, Cuba; 137 cases under treatment. The mortality among those treated with ipecacuanha and calomel, opium, etc., amounted to 9 per cent., while that among those treated by benzonaphthol was slightly above 2 per cent. Forty-five grains per diem were given to adults and but little less to children. Jose A. Clark (*Lancet*, July 20, '95).

Experience in Bengal has given great faith in ipecacuanha in large doses. Castor-oil should be given the night before and, after the bowels have moved in the early morning, tincture of opium, followed in fifteen or twenty minutes by ipecacuanha in a dose of 25 or 30 grains. The patient should lie undisturbed for four or five hours. Should vomiting occur, ipecacuanha to be repeated in half an hour and also if the stool has not much changed for the better within twenty-four hours. Ipecacuanha in pill, in doses of from 3 to 5 grains, is utterly useless. W. J. Buchanan (*Practitioner*, Dec., '97).

Ipecacuanha tried several years in Nicaragua, Central America. Notwithstanding its vaunted efficacy, no case derived much benefit from it. Patients suffering from dysentery cannot always retain large doses, as stated in textbooks. Half-ounce doses of a saturated solution of magnesium sulphate and 15 minims of dilute sulphuric acid every two hours, with milk diet, caused all traces of blood to disappear from the stools in twenty-four hours, and there was, of course, a complete absence of the distressing nausea which is always present in the treatment of ipecacuanha. T. R. Wigglesworth (*Brit. Med. Jour.*, Feb. 26, '98).

Ipecac is indicated in almost every form and type of acute dysentery owing to its simplicity, its safety, and its certainty, compared with any other method. The promptitude with which the inflammation is stopped. The rapidity with which repair takes place (*a*) by resolution or (*b*) by granulation and cicatrization. Conservatism of the constitutional powers. Abbreviation of the

period required for convalescence. Decrease in the frequency of recurrence. Decrease in the frequency of abscess of the liver. Diminution of mortality in cases treated. The chief objection to ipecac is its frequent rejection from the stomach. Its administration in the form of compressed pills coated with salol is recommended to avoid this untoward feature. William Roberts (*Jour. Amer. Med. Assoc.*, April 11, 1903).

Corrosive sublimate, in doses of $\frac{1}{100}$ grain, repeated every two hours, has been recommended by Ringer. Bismuth in large doses— $\frac{1}{2}$ to 1 drachm every 2 hours, amounting to 12 to 15 drachms in 24 hours—often has a beneficial effect. Its effects are more pronounced in the chronic than in the acute cases.

The administration of antiseptic substances by the mouth for the purpose of disinfecting the intestinal canal has been employed. For this purpose benzonaphthol is the drug to be chosen when there is suspicion of liver or kidney disease, and in their absence it is as effective as betanaphthol and resorcin, which are also employed as intestinal antiseptics. The dose of benzonaphthol is 40 to 80 grains, given during 24 hours, in divided doses every 2, 3, or 4 hours. Betanaphthol and resorcin are given in quantities of from 30 to 50 grains in 24 hours in much the same way. The naphthol preparations, being insoluble, must be given in capsules or dissolved in oil and emulsified. Resorcin is soluble and can be readily administered. Naphthalin (20 grains per day) and salol (30 to 40 grains per day) are used for the same purpose. Opium is an invaluable remedy for the relief of pain and to quiet the peristalsis, but should be employed cautiously. It is to be administered hypodermically in the form of morphine, according to the needs of the patient.

Sulphur successfully used in the treatment of dysentery. Twenty grains of

sublimed sulphur are combined with 5 grains of Dover's powder; to be given four-hourly. In all of the cases that have been treated with sulphur the recovery has been rapid and the patient has seemed to derive relief more speedily from his pain and straining than with other methods of treatment. The cure with sulphur seems to be more certain and stable, as chronic conditions and relapses have not occurred. Blood and mucus are easily stopped and the motions quickly become fecal. In some cases the number of motions *per diem* did not at once diminish, but the pain and straining were lessened and the character of the motions became more fecal and contained little or no blood. As soon as the diarrhoea becomes less, it is advisable to give the powders less frequently. G. E. Richmond (Lancet, June 15, 1901).

Three acute and fifteen chronic cases of amœbic dysentery were treated with sulphur of natural spring in the Philippines. The acute cases were given one bath daily and plenty of the water to drink. In a month two were cured; the third, an alcoholic, had to be returned to medicinal treatment. The chronic cases were given two baths daily and the water to drink, and all were cured in from three to six weeks. The springs contained water at 220° F. and 92° F., with a large percentage of sulphur. T. H. Weisenburg (Phila. Med. Jour., March 14, 1903).

Irrigation of the bowel is both rational and useful. To overcome the extreme irritability of the rectum in the acute cases a suppository or solution (4 per cent.) of cocaine should be introduced as a preliminary measure. The irrigation is made with the long rectal tube, the patient being in the dorsal position, with a pillow under the hips. The substance to be injected is water at 100° alone or containing some astringent drug: alum, acetate of lead, sulphate of zinc or copper, nitrate of silver, or tannin. Tannin, in 0.5 per cent. solution, is highly recommended by Kartulis, who

also uses this drug in combating amœbic dysentery. Osler regards nitrate of silver as the best, although not in the very acute cases. In the chronic form it is, perhaps, the most satisfactory treatment. The solution, in this class of cases, is to be made 20 to 30 grains to the pint, and, if possible, 3 to 6 pints of fluid are injected. At times the irrigation causes much pain and is immediately rejected.

For destroying the organisms and stimulating the ulcers, solutions of quinine, creolin, and silver nitrate tried; the latter gave the best results. West (Med. Record, Sept. 23, '93).

Iodized starch internally tried in more than a hundred cases, giving a mixture of equal parts of iodized starch, oil of cinnamon, and oil of fennel, about 1 grain four times a day. At the same time irrigations with a solution of iodized starch to which are added a few drops of chloroform, tincture of iodine, and oil of cinnamon given. Kotschorowsky (Semaine Méd., No. 62, '96).

Two severe cases in which 1-per-cent. solutions of creolin used, with excellent results, in severe dysentery. A pint and a half of the solution was used night and morning. Creolin is worthy of an extended trial in dysentery. George Johnston (Treatment, June 24, '97).

Antipyrine used in a case of severe acute dysentery, by rectal injection three times a day of a solution of 75 grains dissolved in 1/2 pint of water. Sedative action of the antipyrine greatly alleviated the patient, who gained strength and soon recovered. Ardin-Delteil (Bull. Gén. de Thér., Jan. 30, '98).

Rectal injection of permanganate of potassium in the strength of 8 grains to the quart effective. Half of this quantity is given at a dose, and is allowed to remain in the bowel from half a minute to two minutes. The water is either cold or warm, according to the needs of the case. If large quantities of mucus are present, an injection of a pint of water containing 30 grains of bicarbonate of sodium is to be previously used. Gastinel (Jour. de Méd. de Paris, Nov. 19, '99).

Methylene-blue as a parasiticide aims at the pathogenic cause; as analgesic, it reduces the hyperexcitability of the large intestine; as a cholagogue, it has a very pronounced cholagogic effect. It is administered in warm injections of a litre or of half a litre at first until the intestine becomes tolerant, containing in solution from 1 to 2 decigrammes of the drug. Two to four injections are given daily. Berthier (*La Méd. Moderne*, Oct. 10, 1900).

Inflation of the rectum with carbonic-acid gas acts at once by anæsthetizing, relieving the tenesmus which characterizes dysentery, and stimulates the circulation, thereby relieving inflammation. It is a more effective means than the well-known aqueous or starchy enemata. A. Rose (*N. Y. Med. Jour.*, July 14, 1900).

Powdered cinnamon an excellent remedial agent in all cases ranging from ordinary diarrhoea to severe cases of dysentery. It may be given in teaspoonful doses mixed with a little milk to mold it into the shape of a bolus, and chewed night and morning. A. N. Wilkinson (*Brit. Med. Jour.*, Feb. 10, 1900).

Ko-sam (*brucea Sumatrana*) is very useful in the treatment of dysentery of Cochin China. There were 799 radical cures after a period of from three to six days. Only 8 cases resisted the treatment. Ten grains are given the first day, 12 grains the second, third, and fourth, if necessary. The active principle of the plant appears to be quassine. Mongeot (*Tribune Méd.*, June, 1900).

In amœbic dysentery the use of quinine irrigations was introduced by Losch, who found that solutions of 1 to 5000 destroyed the organisms. Stronger solutions—1 to 2500, 1 to 1000, and 1 to 500—are borne well and may be injected three or four times a day. Corrosive sublimate in solution of 1 to 500 or 1 to 3000, and nitrate of silver, 30 grains to the quart, are also beneficial, but must be used more cautiously. H. F. Harris has seen benefit result from the use of hydrogen peroxide in some cases. The

ordinary commercial hydrogen peroxide is diluted from four to eight times with water and about a quart injected twice daily. The treatment is continued for one week and then the quantity gradually diminished.

Fifty-four cases treated by enemata of corrosive sublimate, 1 to 5000, of which 6 ounces were injected three times a day; later on a solution of 1 to 3000 was injected twice daily. The fluid was not retained usually longer than ten minutes. Cases cured in from 1 to 3 days. In no case was there any sign of systemic poisoning. Lemoine (*Bull. Gén. de Thér.*, Jan. 30, '90).

In dysentery of the newborn small doses of calomel, flushing the colon with a weak solution of creolin, and giving the child nothing but pure cold water prove rapidly effective. Gibson (*St. Louis Med. Era*, Sept., 1900).

In Natal success attended the use of mercury perchloride in mixture with bismuth and opium. Milk was found unsuitable. Beef-tea and bread with butter satisfy, and leave a residue which appears to cause but little colic or rectal irritation. Post-mortem observations show that great risk must frequently accompany the giving of rectal injections, especially when combined with abdominal massage. The co-existence of enteric fever with dysentery was more than once unexpectedly disclosed in the mortuary tent. W. Watkins Pitchford (*Brit. Med. Jour.*, Nov. 1, 1900).

For any of these measures to be effective in amœbic cases, they must be continued until the amœbæ disappear. In order to decide this an intermission of a couple of days is made in the treatment. If at the end of this time amœbæ are still present the procedures must be renewed. In the gangrenous cases little good can be looked for from the injections, and, indeed, they are not without danger of precipitating a fatal termination by causing perforation of the already-much-injured intestine.

When tenesmus is slight an enema of

thin starch containing $\frac{1}{2}$ to 1 drachm of laudanum affords great relief; for the more severe tormina and tenesmus the hypodermic injection of morphine is the only satisfactory remedy.

Case of colostomy for the cure of dysentery. The idea of the operation is: (1) to give the bowel a complete rest by not allowing the fæcal mass to pass over it, and (2) irrigation can be carried out with better success. Previous to the operation the patient suffered considerable pain, with high fever; these subsided two days after the operation, and amœba coli also disappeared. W. N. Sullivan (Jour. Amer. Med. Assoc., Dec. 8, 1900).

During the period of convalescence tonics containing some form of iron and a nourishing, but unirritating, diet are to be ordered. The recuperation of the patient's strength is to be facilitated by these and other well-known means.

Method of obtaining and testing therapeutic serum for use in dysentery. The horse or ass was used as the immune animal, an antiseptic (carbolic acid) was added to the serum, and the testing was carried out on guinea-pigs and mice. The author has treated 470 cases of dysentery since 1897; of these, 258 had the serum. It was injected into the side of the chest, and the dose varied from 6 to 10 cubic centimetres in mild cases to 15 to 20 cubic centimetres in serious ones. Usually the site of the injection showed no change. An eruption around the site occasionally followed (37 per cent.); this was very rarely found all over the body (2.5 per cent.), and sometimes there was pain in the joints (knee, elbow, wrist). If the treatment was carried out in the early stages of the disease, the diarrhœa disappeared and in two or three days normal stools were passed; but, if it was given at the time when the stools were muco-sanguineous, the diarrhœa was only diminished, and the duration of the illness was somewhat shortened. With the serum the mortality was from 12.5 to 8.5 per cent.; with medicinal treat-

ment it was 35.6 per cent. K. Shiga (Brit. Med. Jour., from Sei-i-Kwai Med. Jour., June 30, 1901).

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DYSMENORRHOEA. — Gr., *δυσ*, difficult; *μηρία*, menses; and *ρῆν*, to flow.

Definition.—Dysmenorrhœa is not a disease, it is only a symptom. The term has often been used in a very loose way to signify any or all the painful or other disagreeable sensations which may be associated with the abnormal performance of the function of menstruation. The headaches, the pains in the joints and muscles, the backaches, the nausea and vomiting which are of such frequent occurrence at the menstrual epoch do not constitute dysmenorrhœa, though they are doubtless influenced by the same cause which produces dysmenorrhœa. This symptom must be referred to the pelvic organs, to their nervous system, and to their vascular system; in other words, dysmenorrhœa is pain in the pelvic organs which is experienced in connection with the function of menstruation. It is a symptom of a pathological condition. A woman who is in perfect physical condition menstruates without pain.

Dysmenorrhœa may, therefore, be defined as a deviation from normal menstruation, menstruation meaning essentially a monthly congestion of the vascular system of the pelvis in obedience to a recurring impulse, with the shedding of more or less of the endometrium and the discharge of glandular secretions, the tension of the vascular system being relieved by the discharge through the uterine canal of a greater or smaller quantity of blood.

Symptoms.—The pain of dysmenorrhœa differs as to the time of its occur-

rence, its intensity, its duration, and the conditions which produce it. It occurs most frequently during the day or the two or three days which precede the menstrual flow.

In ovarian dysmenorrhœa, usually within twenty-four to forty-eight hours before flow appears the patient is seized with sharp, darting pains in one or both ovarian regions, generally the left. This pain remains constant or increases, until finally a show of blood takes place. The pain is not in the median line, but on either side, and in this respect the pain differs from that due to a uterine cause. Mundé (Med. Brief, May, '96).

Report of 20 cases of intermenstrual dysmenorrhœa, besides 25 collected from literature. The pain generally occurred from 12 to 16 days after the beginning of the previous menstruation and continued from 2 to 4 days, reached its maximum on the first or second day, was often different in character from the menstrual pain, and was rarely accompanied by discharge. Attributed to awakening of menstrual activity for the coming menstrual period. Malcolm Storer (Boston Med. and Surg. Jour., Apr. 19, 1900).

With many women the beginning of the flow means the relief of tension and the relief also of pain; with others it continues, sometimes diminishing, sometimes retaining its acuteness until the pelvic congestion has subsided.

There are two conditions present in antelexion which are responsible for the pain. One is the swelling of the uterine mucosa which accompanies the flow, the other the condition of abnormal sensitiveness at the internal os. The tissues at the os internum are apt to be more rigid than normal and the nerves in an extremely-hyperæsthetic state. The increased congestion which accompanies the onset of menstruation and the tension of the tissues generally irritate the nerves and aggravate the pain. This is the case during the first few hours of the flow. Later the tissues become relaxed, and the canal, to a certain extent, straightened, and the pain disappears. After a time varying from twelve to

twenty-four hours relaxation has occurred, the flow is more profuse, and the pain has largely ceased. Davenport (Boston Med. and Surg. Jour., June 2, '98).

In intensity it may be a simple ache, a feeling of distension within the pelvis, or it may be an acute, continuous, neuralgia-like sensation. It is often spasmodic in character, with a feeling of contraction or bearing down in the uterus, and may be relieved when a clot or gush of blood is ejected from the uterine cavity. The acuteness of the pain is also governed by the temperament of the patient, a highly-organized sensitive person suffering more than a phlegmatic, insensitive one. It is more frequently experienced in damp than in dry weather, at the seashore rather than at the mountains, during an ocean-voyage rather than on a journey inland. The more scar-tissue there is in and around the uterus, the greater the flexion of the organ, and the narrower the cervical canal, usually the more constant will be the occurrence of pain.

The customary classifications which can be verified by anyone with a few years of practical experience are, for the most part, satisfactory, but the writer has adopted the following as the results of his experience, viz.:—

1. Dysmenorrhœa from congestion.
2. Dysmenorrhœa from obstruction.
3. Dysmenorrhœa from neuroses.
4. Dysmenorrhœa from endometrial hypertrophy.

1. Dysmenorrhœa from congestion. This is the simplest of all the varieties. Congestion is always and necessarily a feature of menstruation; that is, the current in the pelvic vessels is then more rapid or the tension or volume is greater, or perhaps all these elements are combined. When the degree of this congestion is greater than can be readily tolerated by the person, pain is one of

its results (the other results need not concern us now), and this pain will last as long as the congestion continues, and will recur as frequently. Tolerance of this condition to a greater or lesser extent is acquired by many women, just as other disagreeable experiences become tolerable when habitual and inevitable. In some cases the pain seems limited to one or both ovaries, in others to the uterus, and in others it seems to be distributed through the pelvis.

2. Dysmenorrhœa from obstruction. There has been much discussion for many years concerning this variety, some writers going as far as to say that the vascular system of the pelvis was so accommodative that dysmenorrhœa from obstruction was not possible. Clinical facts do not warrant such a statement. Obstruction of the outflow of blood is, perhaps, not so great when the womb is flexed backward or forward as was claimed a few years ago by Sims, Hewitt, and others, especially if coagulation of the blood within the uterus does not occur; but, if such coagulation does take place (and in some cases also in which it does not), dysmenorrhœa will be a very pronounced symptom.

With stenosis of the cervical canal the same difficulty to the outflow of the menstrual product is also frequently observed. With imperforation of the hymen or of the os internum or externum obstruction to outflow is complete. A certain portion of the transuded blood is reabsorbed, but the remainder persists, distending the vagina or the uterus or both, sometimes producing a very large tumor, and invariably resulting in great pain, which in some cases has led to a fatal result.

Pain from incomplete development of the pelvic organs, especially the uterus, is also to be referred to obstructive dys-

menorrhœa as its origin, and, as in certain cases of congestive dysmenorrhœa, the bad symptoms are not limited to pain. Dysmenorrhœa from inflammatory exudate is an acquired symptom, the exudate binding the pelvic organs into a more or less firm mass, which tends to become firmer as the contraction, which time brings with it, takes place. The pain in such cases is not limited to obstruction to outflow; indeed, there is no such obstruction apparent in some of the cases, the flow being profuse in some instances and scanty or absent in others. The remarks concerning inflammatory exudate will also apply to scar-tissue, which, by its presence, will often effectually obstruct the passage of the menstrual blood-current. To this variety of dysmenorrhœa might also be added those cases which are so often seen that depend upon perverted or imperfect nutrition and in which constipation is an ever-present accompanying symptom.

3. Dysmenorrhœa from neuroses. There may be at least two types of this variety; in one of them the neurosis is the sole discoverable source of trouble, in the other it is secondary to disease of some other character within the pelvis.

Hysteria is at the foundation of many of the cases of the first-mentioned variety, the pain connected with menstruation being, to a great extent, simulated or imagined.

When we realize, however, the intimate anatomical relations which the sympathetic nerves of the pelvic organs bear to the nerves and ganglia of the rest of the organs of the body, we are quite prepared to believe that painful sensations in those organs might be transmitted to the organs of the pelvis. So far as I know there have been no exact investigations upon this subject. The referred or reflected pains from the pelvis to the other

organs have been much discussed and a variety of conclusions has been reached. The neuroses in the pelvis or pelvic organs which occasion dysmenorrhœa may constitute a use of language which is somewhat misleading. Of course, all pain is the evidence of nerve-irritation or a neurosis. The form which is here to be considered is that in which, aside from mere congestion or obstruction as an attendant of the menstrual experience, there is a direct irritation of nerve-tissue which is not apparent apart from the menstrual epoch. Such, for example, is the case when the unusual pressure due to the congestion of menstruation is experienced by the sacral nerves as they pass through the pelvis, the tissues being already the seat of inflammatory exudate. The tissues are squeezed and contracted by this exudate; but the addition of the menstrual congestion introduces a further element of pressure, which causes irritation of the nerves which are infringed upon, and pain is experienced, which radiates in the direction of the imprisoned nerves. This condition is not infrequently found in insane women; it is probably a factor in producing insanity, and such insanity cannot be expected to ameliorate permanently until the source of trouble is removed.

4. Dysmenorrhœa membranosa. This is a somewhat rare form of dysmenorrhœa, but one which has long been recognized, and is described by all writers of gynecological treatises.

During ten years' experience, case of membranous dysmenorrhœa never met with. The spasmodic-neuralgic form without any pathological lesion is also extremely rare. The worst cases are usually due to ante flexion. Dilatation gives relief, but must be repeated. There is not any scientific proof that the ovary *per se* ever caused dysmenorrhœa. When

no lesion can be found the fault is in the nervous system, and to this the attention must be directed. Fibroma not infrequently causes dysmenorrhœa, even in women under 30. The tumor may be very small and escape notice, unless a careful examination is made under an anæsthetic. Parsons (Brit. Med. Jour., Oct. 24, '97).

Dysmenorrhœa membranosa is due to an hypertrophied condition of the endometrial decidua; that is, of the exfoliative portion of the uterine mucous membrane which is shed at each menstrual epoch. This membrane varies in thickness and density in extreme instances, showing a perfect cast of the cavity of the uterus.

Separation of the membrane from its underlying attachment and its expulsion from the uterus mean an unusual amount of uterine work and severe pain as an almost constant accompaniment. It usually occurs, too, in women whose nutrition is defective, and is consequently a matter of more serious importance than if it were among the robust and well nourished. It is, of course, a form of obstructive dysmenorrhœa, but its peculiarities are so marked that it may be well to continue to consider it a distinct variety.

Etiology and Pathology.—Anything which prevents or disturbs the equilibrium of the normal conditions described will cause dysmenorrhœa. It is of exceedingly frequent occurrence. It is a matter of great surprise that so many women should present this symptom, which appears with some of them at the advent of puberty and continues with varying intensity until the termination of menstrual life, while with others it disappears with pregnancy, with the physical changes attending mature life, or as the result of surgical treatment.

That it should occur so frequently, and

especially in communities in which the highest intellectual development has been reached, is not a flattering commentary upon the results of modern civilization. Still, this is counterbalanced by the fact that dysmenorrhœa is usually curable by judicious and appropriate surgical means.

A thorough revision of our views on this subject has become necessary in the light of recent experience. More than 75 per cent. of the cases of painful menstruation are not dependent upon anatomical causes. The pain is really due to tetanic contraction of the circular muscle at the os internum, such as occurs in other sphincter-muscles in neurotic subjects. Menge's theory that dysmenorrhœa is due simply to an exaggeration of the contractions of the longitudinal muscular fibres, which always accompany normal menstruation, does not hold, for, if the symptoms were due purely to mechanical obstruction, it should invariably disappear after childbirth, which is not the case in nervous and hysterical women. Uterine colic cannot be due only to the passage of clots, since in many typical cases of dysmenorrhœa there is a free escape of fluid blood. Moreover, the pains are often most severe from twelve to twenty-four hours before the flow appears, instead of on the second or third day, when it is most profuse and clots usually appear. Theilhaber (*Centralb. f. Gynäk.*, No. 3, 1902).

Women in the savage or barbarous state and women who are constantly engaged in out-of-door labor are seldom sufferers from this cause, though their pelvic organs may be defective in structure and though they may habitually be subject to experiences which would unfailingly cause dysmenorrhœa or even complete suppression of the menstrual function in women of less robust organization. This is, in part, owed to the increased power of resistance to physical ills which is favored by an out-of-door

life, and, in part, to the greater insensitiveness to pain of women in the lower strata of social and intellectual development.

With those who are sufferers the underlying causes are various, and demonstrate the important rôle which the reproductive organs play, not alone in the propagation of species, but in the experiences of daily life.

One hundred and twelve cases of dysmenorrhœa examined. One of the most striking points is the very large number of sterile women; 44, or a fraction less than 40 per cent., belong to this class. Of those who had been pregnant, 12 had never had a child at full term; 15 more had had a miscarriage since the last full-term child was born, leaving less than 37 per cent. of the total number whose last pregnancy had come to full term. These figures would seem to indicate that, in a large proportion of patients suffering from dysmenorrhœa, there were present lesions which also interfered with conception. One hundred out of the 112 suffering from painful menstruation were found to have some marked organic lesion of the pelvic organs. William S. Gardner (*Atlanta Med. and Surg. Jour.*, Dec., '95).

The causes may be classified as follows, viz.: heredity, disease, occupation, and trauma.

1. Heredity. With many women the defects in the structure of the reproductive organs are congenital and necessitate dysmenorrhœa.

Uterine dysmenorrhœa is caused by a malformation of the uterus, due to want of proper development. To this are added the thickening of the mucous membrane and congestion at the time of the menstrual flow. The bend, plus the thickening of the mucous membrane and congestion, is the cause of the pain. On examination, antelexion of the uterus is almost certain to be found. Keith (*Brit. Gyn. Jour.*, Nov., '97).

Inflammatory diseases of the ovaries and the Fallopian tubes and adhesive de-

formities of the uterus are at times the causes of dysmenorrhœa. In 100 of Kelly's operations on tubes and ovaries the appendix was found adherent in 21 cases, and in 7 it required removal. Out of 58 personal cases in which inflammatory appendages had to be removed, the appendix showed enough evidence of disease to justify removal in 20 cases. In 9 of these the adhesions between the appendix and the right appendage were very intimate. A. MacLaren (*Amer. Gynec. and Obstet. Jour.*, July, 1900).

It does not avail that the remainder of the physical organization is normally developed; indeed, one frequently sees women of the finest physique and superb presence whose incomplete pelvic apparatus condemns them to semi-invalidism during a considerable portion of each month.

On the other hand, puny, delicate women with normally-developed pelvic organs suffer with dysmenorrhœa on account of their perverted general nutrition, their flabby muscular system, and their low-ebb vitality, to which the recurring monthly congestion brings a strain which they are ill fitted to bear.

The defective organization may include any portion of the genital apparatus; in the vulva it may take the form of an impermeable hymen, producing an absolute barrier to the discharge of imprisoned blood; in the vagina it may consist of bands and septa with almost equal obstruction to the outflow of the menstrual fluid; in the uterus it may be an almost-impervious cervical canal, an occluded os internum or externum, less frequently a rudimentary corpus uteri or one with its two halves uncoalesced or its canal obliterated; in the tubes or ovaries the structure may be rudimentary or the seat of some form of congenital disease.

Stenosis may be due to swelling of the mucous membrane occurring only at the time of menstruation, and consequently

impossible to diagnose at other times. Treub (*Centralb. f. Gynäk.*, July 17, '97).

Dysmenorrhœa should be divided into dysmenorrhœal endometritis and uterine spasm. The first includes all forms in which there is any local mechanical obstacle; all other cases are uterine spasm, which affects the sphincter of the uterus, —that is, the cervix. Of 167 patients observed, 37 complained of painful menstruation. In 32 a local cause was discovered, but in the 5 others, virgins, the affection was spasmodic. Besides there were 21 who had manifest stenosis without painful menstruation. Among these subjected to curetting there were 17 with dysmenorrhœa, but only 1 had marked stenosis. Of these last, 8 were completely cured by curetting; of the 9 others, 7 returned with a relapse of their old trouble, and 2 received absolutely no relief. De Leon (*Centralb. f. Gynäk.*, July 17, '97).

Painful menstruation often co-exists with acute antelexion of the uterus. The class of patients who suffer from this type of disease are usually, if married, sterile, and the supervention of pregnancy often effects a cure. Williams (*Brit. Med. Jour.*, Oct. 24, '97).

Membranous dysmenorrhœa has no connection with pregnancy or abortion, is not productive of sterility, and can become cured spontaneously. The fibrinous membranes are to be regarded as true dysmenorrhœic membranes, and are not dependent upon an inflammation of the uterine mucosa. Fibrinous membranes are the product of necrosis originating in hæmorrhage and transudation. Kollmann (*Wiener klin. Rund.*, Apr. 29, 1900).

In all cases thus connected with heredity, defective organization, etc., recurring monthly congestion produces tension in poorly-conditioned structures, and, if the tension in the vessels is sufficient to result in transudation of their contents, the outlet being imperfect or wanting, pain will be the inevitable result.

2. Disease. Disease of one kind or another may cause dysmenorrhœa, whether

the disease occurs before or after puberty. Before puberty there are many forms of disease which arrest the development of the pelvic organs and result in dysmenorrhœa. The exanthemata seem to be especially productive of this effect. Why this should follow has not been satisfactorily explained. Measles, scarlet fever, small-pox, all have their victims in whom such a result has been observed.

Of the diseases subsequent to puberty which produce dysmenorrhœa there are those which are local and others which are general. Of the former may be mentioned fibroid tumors either within the uterine canal, in its muscular substance, or within its peritoneum, and inflammatory disease of the tubes of the ovaries or of the pelvic peritoneum. All these diseases may, by their obstructive effect, prevent free discharge of blood during the menstrual epoch, and produce pain. Of the general diseases may be mentioned typhoid fever, certain diseases of the liver and gall-bladder, anæmia, etc.

The same result is often seen in cases in which there is excessive development of fat. Women who become very obese are very frequently sufferers from dysmenorrhœa.

3. Occupation. Some occupations are especially prone to result in dysmenorrhœa. Those who work in a very hot atmosphere, like cooks and laundresses; those who are constantly exposed to cold and dampness, like fishwives or workers in mines (unwomanly occupations); those who work in poisonous substances, —copper, arsenic, lead, phosphorus, and sulphur; those who are confined for long hours in factories, stores, and tenement-house "sweat-shops" are, in many instances, sufferers with dysmenorrhœa.

[It is a pity that civilization, which has done so much to ameliorate many physical evils, has also brought in its wake many others. The field for philan-

thropy and preventive medicine, in this direction, is a very wide one, and legislation has yet much to do in emancipating women from such distressing experience. A. F. CURRIER.]

4. Trauma. Dysmenorrhœa from this cause is, in most cases, the result of difficult parturition, the genital organs sustaining severe injuries and cicatrization and contraction ensuing. The hardened tissues are anæmic and the necessary elimination of blood is accomplished with difficulty and pain. Occasionally there are direct injuries to the genital organs, apart from parturition, which also produce deterioration of the tissues of those organs, and are likewise followed by painful menstruation.

Prognosis.—The prognosis in dysmenorrhœa varies with the conditions and varies also with the treatment. If it depends upon structural defects, and those defects are remediable, a cure will result. It sometimes persists during the whole menstrual life, but with many women it gradually becomes tolerable, as all ills which are long endured become tolerable.

With regard to prognosis much will depend upon the general condition of the subject, great improvement in that direction often leading to menstruation, which is less painful or not painful at all. The prognosis in cases in which drug-treatment alone is used is very uncertain; while such treatment is proper enough simply as a means of relieving or benumbing pain, it has nothing more than a temporary and palliative effect when the pain is due to an anatomical fault or defect.

Treatment.—It might be quite apparent from the foregoing that, while the treatment may be either medical or surgical, the latter, however, will usually give the more satisfactory and radical results. Modern gynæcology is cast in

surgical lines, and while it would be folly to deny that many mistakes have been made in its name (for mistakes are always made in the development of a new department of knowledge), it has approached nearer to fundamental conditions by directly attacking tissues which are involved in disease than have other methods of treatment which are more circuitous in their course.

Considering the subject of treatment, therefore, as divisible into palliative and radical, the former will include the methods by means of drugs (which occasionally may produce a permanent result), and the latter (which do not infallibly produce a cure) those methods which involve surgical procedures. Of course, a judicious combination of both medical and surgical means will often prove efficacious.

Of the drugs which may be given to relieve the pain of menstruation, morphine combined with atropine should be reserved for very rare cases whether given by the mouth or hypodermically. It should be given in the smallest possible doses, $\frac{1}{8}$ grain sufficing to relieve pain in most cases as well as a larger quantity. One must not forget the seductive influence of this drug, especially upon real nervous, hysterical women. Many women find relief from the pain in question by drinking hot herb-teas: chamomile, scutellarium, boneset, flaxseed, etc. These can do no harm and are innocent as to the formation of drug-habits.

More or less meritorious preparations are much in vogue, but in some cases they seem to be entirely inert, either from instability or want of uniformity in the preparation or some peculiarity in the patient.

Oxalate of cerium, in 6-grain doses every hour, considered specific for the dysmenorrhœa of well-nourished, robust women, in cases where the pain comes

at or before the beginning of the flow. Chambers (Med. Record, July 7, '88).

Apiolin is especially indicated in spasmodic and congestive dysmenorrhœa, in doses of 3 minims in capsules, three times a day. Hill (Med. Standard, June, '91).

In non-inflammatory cases viburnum prunifolium gives brilliant results, not to be obtained from any other remedy except morphine. A teaspoonful of the fluid extract three times daily to be given. Schwartze (Ther. Gaz., Aug. 15, '94).

Manganese is a most valuable remedy in unmarried women, and a trial extending over three months is recommended before relinquishing its use. Its action appears to be upon the nerves or nerve-centres concerned in the menstrual function rather than upon the blood. Administration of manganese does not interfere in any way with iron and vegetable tonics, but rather enhances their effects. The black oxide is the most convenient form of prescription. If nausea is produced the drug should be given in a small dose: 1 grain at a time gradually increased. A 3-grain dose is found to be as efficacious as a larger one. Charles O'Donovan (Med. News, Nov. 27, '97).

The following formula has given good results:—

R̄ Tincture of hydrastis Canadensis,
Tincture of viburnum prunifolium,
of each, equal parts.

M. Ten drops to be taken every two hours. Lutaud (Jour. de Méd. de Paris, Jan. 2, '98).

Cases in which the flow is ushered in by severe cramp-like pains for three or four days preceding the menstruation $\frac{1}{2}$ -drachm doses of the fluid extract of viburnum prunifolium in hot water three times a day may be given, and on the morning of the expected period a full dose of magnesium sulphate. If the pain comes on in spite of this, 5-grain doses of antipyrine, repeated every two hours for three doses, if necessary, will often relieve it. Arthur A. Browne (Montreal Med. Jour., Apr., '98).

In dysmenorrhœa thyroïdin is "a uterine and ovarian anodyne and seda-

tive, as it arrests the different impressions at their formation." One grain of thyroïdin is given in capsules thrice daily, for two days before menstruation is due; the quantity is increased to 2 grains thrice daily during the flow. Relief is afforded in over 80 per cent. of cases. The treatment is efficient when the uterus and ovaries are in normal position. Any pathological lesion must be remedied by proper surgical measures. Stinson (*Amer. Jour. of Obstetrics*, July, 1902).

The various currents of electricity have all been vaunted as useful means of treatment, and in many cases they are prompt in producing relief. Especially is this true of the faradic current, but if the cause of the trouble lies in a defect of structure it would be unreasonable to expect a permanent result from electrical treatment so long as the cause remains.

Other palliative measures are warm hip-baths in which the patient may sit ten to fifteen minutes, the temperature of the water being sufficient to produce relaxation of tissue, and hot mustard-water foot-baths, which must be used only long enough to produce a glow of the skin.

Hot salt-baths calm the pains of dysmenorrhœa and notably diminish menstrual flow. Mironoff (*Ejenedelnoya*, No. 35, '95).

In ovarian dysmenorrhœa all remedies which are likely to relieve pelvic congestion should be employed, such as hot injections and sitz-baths, hot-water bags to the lower part of the abdomen, and saline laxatives. Internal medication is of very little avail. In cases, however, in which menstruation is not profuse the mother-tincture of pulsatilla in 5-drop doses every three hours is very useful. Mundé (*Med. Brief*, May, '96).

With mud-baths and the medicated waters of Kreuznach, Aix, Toplitz, Schwalbach, and other well-known European resorts useful results have been obtained, but they are not available for the majority of our American patients.

A change of residence, especially from the sea-shore or near the sea-level to an elevation of one or two thousand feet, will often give permanent relief. The writer has repeatedly seen women who menstruate with great discomfort at the sea-shore, while on sea-voyages, or in a damp atmosphere under some other conditions. Of course, if there is no anatomical lesion one usually becomes habituated to atmospheric conditions after a few months or years.

If the pain is due to a neurosis the treatment should be addressed to the nervous system,—the bromides, hyoseyamus, aconite, and the coal-tar preparations being employed.

If the general nutrition is at fault it is hardly necessary to say that it should be improved by a carefully-selected diet, suitable exercise, cheerful companionship, and always and above all by the use of approved laxatives to keep the bowels freely open. Again and again has the writer found a constipated habit at the bottom of a history of painful menstruation.

The majority of cases of dysmenorrhœa in school-girls is functional in origin. Environment should be such as would be most conducive to their general health. They should be kept out of school during their first menstrual year, and those of a nervous temperament for a longer period of time. They should have calisthenic training for the special development of the muscles of the back and abdomen, and should be warmly clothed. If there is any tendency to pain during menstruation, the young patient should be put to bed and kept there the entire period. Pine (*Northwestern Lancet*, Dec. 15, '89).

The field of surgical treatment for dysmenorrhœa is a large one and frequently will result in the happiest consequences. The chief objects of surgical treatment are to relieve obstruction, to

produce stimulation, and to improve local nutrition.

The causes of obstruction have been mentioned, and should be removed as completely as possible; an imperforate hymen should be divided or dissected away; obstructing bands in the vagina should be cut and a series of vaginal dilators worn until the normal caliber of the vagina has been restored. Bands and constrictions at the os externum or internum should be divided, a narrow cervical canal should be dilated and curetted, especially when the glands are the seat of exuberant or unhealthy secretion.

[The most efficient treatment for ordinary forms of dysmenorrhœa is careful dilatation, with the steel dilator, to the extent of an inch or an inch and a quarter, using careful antiseptic precautions. After the dilatation it is well to insert an intra-uterine pencil containing 10 grains of iodoform. MUNDE and WELLS, Assoc. Eds., Annual, '89.]

Slow dilatation urged as being equally effective and less dangerous than rapid dilatation. Talbot (*Amer. Jour. of Obstet.*, Jan., '89).

Rapid dilatation for the relief of dysmenorrhœa depending upon flexion or obstruction is advocated, in the absence of contra-indications. Goodell (*Amer. Lancet*, July, '89); Dickman (*Kansas Med. Catalogue*, June, '89); Townsend (*Amer. Jour. of Obstet.*, Dec., '89); Madden (*Satellite of the Annual*, Sept., '89).

Repeated curettings at short intervals advocated for membranous dysmenorrhœa. After each curetting the canal should be carefully treated to an application of pure carbolic acid. Reamy (*N. Y. Med. Jour.*, June 10, '93).

For membranous dysmenorrhœa, scarification of the os externum at intervals of three or four days between the periods is recommended. Just before the flow is expected the cervix is dilated, the interior of the uterus thoroughly curetted, and a spiral-wire stem introduced; this is worn continuously during at least three subsequent periods, the patient being directed to take hot vaginal douches

even when menstruating. Duke (*Med. Press and Circ.*, July 10, '95).

Dysmenorrhœa is successfully treated by applications to the mucous membrane of the uterine cavity. The treatment consists in the injection of 10 minims of 3-per-cent. mixture of Churchill's tincture of iodine and water into the uterine cavity every four or five days during the intermenstrual period, beginning about five days after the flow has ceased, and giving the last treatment about five days before the next period begins. As an injector a fine glass tube, curved an inch from one end and expanded into a funnel shape at the other, is used. A piece of sheet rubber covers this end, and by the pressure of the finger the contents are passed into the uterine cavity. A speculum is not necessary, the majority of cases being unmarried. The pain and exposure made necessary by the use of a speculum is objected to. Langstaff (*Brooklyn Med. Jour.*, May, '97).

The spasmodic variety is by far the most common, as there is frequently little to be detected beyond the symptom of severe spasmodic pain. Some relief may be obtained by sedatives externally or internally, but there is always the danger of setting up an opium or chloral habit; it is better to dilate the uterus, either by tents or solid instruments. The use of tents is not free from danger, both from sepsis and from fracture or tearing away of a piece of the tent upon extraction. To effect rapid dilatation the solid dilator well regulated is to be chosen. The uterus can be easily secured by the vulsellum forceps if a sound is previously introduced into the cavity, and a series of dilators can then be passed rapidly, with the result that the patient is relieved, at least for many months. Murdoch Cameron (*Brit. Med. Jour.*, Oct. 24, '97).

In sterile married women prescription of abstinence from marital relations for longer or shorter time, followed by free dilatation immediately before their resumption, often proves successful in curing dysmenorrhœa. Bicycling is of advantage, and if growing girls, especially when anæmic, were systematically en-

couraged to practice that exercise in moderation, we should by and by have less spasmodic dysmenorrhœa. Connel (*Brit. Med. Jour.*, Oct. 24, '97).

In every case, without exception, general treatment must be most thoroughly tried first. At the time of puberty many girls get far too little exercise, and too little care is taken to keep them warm, especially at night. It is essential that the feet be kept warm during the night whenever there is uterine dysmenorrhœa, or, indeed, whenever there is any pelvic trouble. As soon as there is the slightest appearance of the "period" the girl must be kept rigidly in bed, and not allowed to get up until the pain is entirely gone. A large poultice should be kept over the abdomen. A brisk saline draught at the commencement, or, if possible, twelve hours before, and then a mild diaphoretic, with a small dose of bromide of sodium or potassium, if the patient be strong, or if weak some aromatic spirit of ammonia are best.

In regard to the local treatment there is more or less difference of opinion. The stem-pessary is unscientific; it can only relieve, seldom cures, and may do harm. Dilatation consists of two kinds: slight and great. The first is suitable in the case of married women, when flexion is not great, and it is used in the hope that by distending the canal impregnation may take place, and the dysmenorrhœa thus be cured. An anæsthetic is not required. Overdilatation may be done with tents or the rapid forcible method. Whatever instrument is used in the rapid method, the stretching ought to be carried out while the uterus is fixed by tenaculum in its natural position; not when it is drawn to or outside the vulva. Keith (*Med. Press and Circ.*, Oct. 27, '97).

Obstruction from the presence of tumors within the uterus which may cause excessive pain can be relieved only by their removal, and the requisite operations must also be performed if the dysmenorrhœa is caused by displacements of the uterus or its incarceration by inflammatory exudate. Any less radical form of treatment for such conditions has, in

the experience of the writer, proved to be only time-consuming and futile.

The causes of dysmenorrhœa may be either extra-uterine or intra-uterine. The treatment differs markedly in the two classes of cases, and what would relieve in one would be worse than useless in the other. Three factors are concerned in the production of the pain of dysmenorrhœa, viz.: contraction of the muscular fibres of the uterus or Fallopian tubes; increased spasm or blood-pressure in the tissues of uterus or appendages,—congestion; neuralgia of the uterus or the appendages. The cause is to be treated. Nearly all cases are benefited by rest at the periods, hot vaginal douches during and between the periods, and, in inflammatory cases, tampons of glycerin and ichthyol, and saline aperients. Morphine and alcohol will give great relief, but must never be recommended; the administration of alcohol to young women at such times is to be blamed for much of the secret drinking that prevails. The drugs most useful are bromides and belladonna, antipyrine and cannabis Indica, and both viburnum prunifolium and viburnum opulus. Operative measures should only be resorted to when other and less severe remedies have failed. In cases due to spasmodic contraction of uterus or stenosis of cervix (if there be no signs of extra-uterine disease) dilatation is often of some service, but is seldom of more than temporary benefit. In cases due to chronic pelvic peritonitis, binding down and matting together the uterus, ovaries, and tubes,—cases in which the ovaries are cystic and the tubes, perhaps, occluded and the uterus retroverted and adherent to the rectum,—very marked and permanent benefit results from a "conservative operation" on the appendages. The abdomen should be opened, the uterus, ovaries, and tubes freed from the adhesions, and after ignipuncture of the cystic or sclerosed ovaries the fundus fixed to anterior abdominal wall. In grave and otherwise incurable lesions of the appendages, such as abscesses of the ovary or pyosalpinx, the removal of the diseased organ is strongly indicated. Martin (*Brit. Med. Jour.*, Oct. 24, '97).

The use of pessaries for the relief of displacements, while it frequently modifies the dysmenorrhœa, seldom cures the displacements; hence such means are used with far less frequency than formerly. The same may be said of the cutting operations which were once so popular for the relief of dysmenorrhœa supposed to be the results of ante flexion of the uterus.

Stimulation of the uterus and improvement of its nutrition are often effectively produced by the passage of

graduated sounds into its canal, the use of the steel dilators, curettage, and occasionally by the abstraction of blood from the cervix with leeches, or by punctures or scarification, especially when the cervix is congested and the menstrual flow is scanty.

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DYSPEPSIA. See STOMACH, DISORDERS OF.

DYSTOCIA. See PARTURITION.

E

EARACHE. See MIDDLE EAR, DIS-EASES OF.

ECLAMPSIA.—Gr., *ἐκλαμψις*, a shining forth.

Synonym.—Puerperal convulsions.

Definition.—Eclampsia is a symptomatic disorder characterized by convulsive or epileptiform seizures that suddenly come on prior to, during, or after labor.

Symptoms.—The physician who systematically examines the urine not alone for albumin and casts, but also for urea, and who keeps check of the amount of urine passed in the twenty-four hours is not likely to be caught napping even in those cases in which, although there never has been a suspicion of renal impairment, the kidneys are nevertheless diseased. *Pari passu* with diminished excretion of urea the risk of toxæmia increases, and the most dangerous form of eclampsia—that which develops suddenly (without much premonition) and passes into coma and death—frequently depends on urinary insufficiency as regards excretion.

The clinical history of cases of the form of toxæmia under consideration is

variable. As a rule, there exists a premonitory symptomatology, consisting in cephalalgia and dimness of vision or alteration from that which is normal in the person.

Instances of convulsions during pregnancy observed in which every fit was regularly preceded by transitory amaurosis, as well as by œdema of the face, which was also of short duration. Two sets of convulsions occurred during pregnancy: the first about the end of the seventh month, four attacks taking place within twenty-four hours; the second in the course of the eighth month, when two fits were observed. After the last convulsion a healthy child was delivered. The mother made a good recovery. The two prominent symptoms above mentioned developed before each of the six fits. Olshausen has been able to collect only three cases of eclampsia in which the fit was preceded by an aura, as was this case. Rabczewsky (*Przegląd Chirurgiczny*, vol. ii, Pt. 3, '95).

Rarely are convulsions unheralded. In the vast majority of cases there were prodromal symptoms. Frequent urinary analyses, both qualitative and quantitative, should be made, and, if albumin is found or the amount of the solids greatly diminished, suspicion should be aroused. Any abnormal symptoms—such as headache, disturbances of vision, or œdema—

should put us on our guard. When such symptoms appear the patient must be put on a milk diet with large quantities of sterilized water; hot baths employed, and the bowels kept active by catharsis and saline enemas. The continuance of these symptoms demands induced labor.

In post-partum eclampsia, if the patient is plethoric and vigorous, venesection is the best remedy; if anæmic and weak, veratrum, accompanied by the transfusion of the salt solution, is indicated. H. D. Thomason (*Med. Record*, May 23, '96).

Albumin and casts may or may not be present in the urine according to whether a nephritis complicates the pregnancy or not. Should the premonitory symptoms be aggravated elimination of urea is defective, as shown by the recognized tests. Insufficiency on the part of the kidneys may be determined by measuring the amount of urine passed in the twenty-four hours. Vascular tension is apt to be increased except in women of an anæmic type; oedema, as a rule, accompanies organic renal disease.

The symptomatology of the eclamptic seizure is characteristic. The wide-open eyes, fixed in vacant stare; the contracted pupils, the rapidly opening and closing lids, the clonic convulsions. These symptoms accompany, ordinarily, the first seizures. The heart's action becomes irregular, the face is cyanosed, the breathing stertorous. Soon the convulsions become tonic in character; the eyes are fixed; opisthotonos may set in.

Much importance attached to severe frontal or unilateral headache, associated with insomnia, as one of the earliest symptoms of eclampsia. F. B. Earle (*Illus. Med. Jour.*, Mar., 1900).

The number of seizures are variable, as many as one hundred and twenty-five in the twenty-four hours have been noted. The duration of the seizures is from about thirty seconds to a minute,

and in the intervals the woman is conscious; or else the first seizure merges into coma and ends in death. Generally, after delivery of the foetus the convulsions cease. Rarely eclampsia develops after delivery.

In the course of four and a half years, among 4480 cases of childbirth, the proportion of cases of eclampsia was 4.9 per thousand. Of the 4480, 2383 were primiparæ and 2097 multiparæ; 16 of these cases of eclampsia were primiparæ, and 6 multiparæ; that is, equal to 72.7 per cent. of primiparæ to 27.3 per cent. of multiparæ. Braun found the percentage of primiparæ 86.3; Löhlein, 85.4; Schauta, 82.6; v. Winckel, 76.8; and Olshausen, 74 per cent. Women attacked with eclampsia were, for the most part, young. The first convulsive seizure occurred before labor in 2 cases, during labor in 15, and after labor in 5 cases. The extent of the discrepancy as to antepartum eclampsia is well brought out by the following figures: Löhlein gives 4.7 per cent.; Strumpf, 7.4; v. Rosthorn, 9.1; Schauta, 14; v. Winckel, 23; Braun, 24; and Olshausen, 40 per cent.

The convulsions ended at the termination of labor in 8 of the 22 cases. The duration of the convulsions was, on the average, one minute. The severity of an eclamptic seizure is only to be measured by its influence on the respiration and the action of the heart. There was albuminuria in the whole of the cases. Knapp (*Monats. f. Geburts. u. Gynäk.*, B. 3, May and June, '96).

Nature frequently teaches us the line of action—spontaneous abortion occurring and the eclampsia ceasing.

Inasmuch as convulsive attacks may persist after delivery, or even in rare cases may appear for the first time after delivery is completed, the plan of hurrying on labor with the object of checking the attacks must necessarily be often completely inefficacious. We may, therefore, conclude that it is not in the evacuation of the uterus that the cure for eclampsia is to be sought. The toxic condition of the blood dominates everything else, and it is on the degree of

toxicity, which is so difficult to determine, that the prognosis of the disease depends. Maygrier (*Jour. de Méd. de Paris*, Aug. 8, '97).

The victims of nephritis who become pregnant rarely go to term, but abort a dead foetus, the result of interstitial alterations in the placenta.

Etiology and Pathology.—Modern belief teaches that eclampsia is the result of a toxæmia. The acceptance of this broad term has done much toward the adoption of a rational method of treatment. The definitions which for long prevailed in medical literature simply complicated the topic. Thus the view that eclampsia depended on pressure of the gravid uterus on the renal vessels, while negated by the fact that such pressure exercised by ovarian and fibroid growths was unaccompanied by eclampsia, and, further, that the gravid uterus, when risen above the pelvic brim, exerted no such mechanical interference with the kidneys, led the mind of the observer far astray from a strong presumptive etiological factor, which is deficient excretion of toxic products emanating not alone from the kidneys, but also from the liver.

The eclampsia symptom-complex is dependent on a peculiar irritation change in the psychomotor centres of the cerebral cortex (subcortical centres). This zone develops during gestation on an existing disposition, which may be either congenital or acquired. Herff (*Münchener med. Woch.*, No. 5, '91).

Puerperal eclampsia originates from a renal insufficiency causing a high arterial pressure, this again reacting on the motor areas of the brain, producing the characteristic epileptiform manifestations in the parts of the body presided over by the centres which are subject to the abnormal blood-pressure. R. Maxwell-Trotter (*Brit. Med. Jour.*, May 9, '96).

Though the pathogenesis of eclampsia is unsettled, it belongs solely to the preg-

nant or puerperal state. It is not apoplectic, epileptic, or hysterical in character. It depends upon toxæmia due to overproduction of toxins and under-elimination by the emunctories. These toxins probably have their origin in the ingesta, in intestinal putrefaction, in foetal metabolism—one or all—and there is co-existing sluggishness, impairment, or suspension of elimination. When the prodromes of eclampsia appear, the kidney should be interrogated as to its functions and all symptoms carefully watched. W. W. Potter (*Amer. Jour. Obst.*, Nov., '97).

The cause of pregnancy-kidney is probably an autointoxication of the organism by a product of metabolism during pregnancy. The overloading of the organism with this virus gives rise to eclampsia. The changes which occur in the kidneys, liver, and other organs in the eclamptic are of a secondary character. Saft (*Archiv f. Gynäk.*, vol. li, p. 2).

While the urine of healthy pregnant women has been reported as sterile, germs may be cultivated from it: the same organisms obtained from the urine of eclampsias. These urines are but feebly toxic when injected subcutaneously in massive doses into animals. Bar (*Obstetrics*, Jan., '99).

The bulk of evidence is distinctly in favor of the belief that a profound toxæmia, originating in the bodies of the mother and foetus, causes eclampsia. The exact agent has not been isolated. An excessive amount of serum-albumin in the urine, accompanied with kidney *débris*, is a symptom of moment. The amount of urea excreted is a valuable index. A diminution in its amount indicates a retention of toxins. Jaundice is an especially grave symptom, and, hæmatogenic in origin in these cases, points to a grave toxæmia. E. P. Davis (*Amer. Gynec. and Obstet. Jour.*, July, '99).

Study of 59 cases of eclampsia in the Imperial Maternity at Kieff. Eclampsia shown to be a primary disease of the kidneys due solely to autoinfection of the patient by the accumulation of waste-products in the maternal and foetal blood. It is essentially a disease of preg-

nancy, not of parturition, and it always tends to interrupt gestation. Abuladze (Monats. f. Geburts. u. Gyn., Sept., '99).

Case of eclampsia complicated by a marked erythema multiforme of a bulbous character. Kaposi ascribes erythema multiforme to: (a) Change of seasons. (b) Angioneuroses which occur principally in women. (c) Instability of the vasomotor centres. (d) Autoinfection: *i.e.*, toxic substances which have entered the blood as the result of some internal disease, as chronic nephritis. The case cited probably comes under the last division. J. D. Voorhees (Med. Record, Oct. 7, '99).

In the Boston Lying-in Hospital during the last fifteen years 90 cases have occurred, although in 11 no convulsions appeared. There were 79 cases of true eclampsia in 6700 deliveries: an average of 11.7 to the thousand. Of these, 57, or 72.2 per cent., were primiparæ, and 22, or 27.8 per cent., were multiparæ. Newell (Boston Med. and Surg. Jour., Nov. 9, '99).

There is no uniform causal factor for puerperal eclampsia. Even slightly toxic products in the blood of women in child-bed are sufficient to irritate the vasomotor centres, which are then in a condition of increased excitability. E. Herz (Wiener med. Woch., Nos. 3, 7, 8, 1900).

Case in which the rapidity of death after the fits suggested cerebral hæmorrhage. Free hæmorrhage was discovered on the surface of the convolutions of the left hemisphere and widely distributed hæmorrhages in the liver: subcapsular, interlobular, and intralobular. Case in which sudden and rapidly fatal asphyxia was caused by cerebral hæmorrhage, which nearly destroyed the bulb and the floor of the fourth ventricle. Boissard (Bull. de la Soc. d'Obstet. de Paris, Feb. 15, 1900).

The etiology of puerperal eclampsia is still a mooted question. The bacteria which were supposed to be the germs causing eclampsia are found in all pregnant women. When the blood of the eclamptic patient is examined, micro-organisms are rarely found, and from observations one can find no positive

proof that any one germ has been isolated which will cause eclampsia. The universal opinion at present is that eclampsia is due to a profound toxæmia, and the origin of this toxæmia is still unknown. Beattie (Jour. Amer. Med. Assoc., Aug. 24, 1901).

The toxic theory of eclampsia is now the one generally held by most obstetricians, and in this connection the following points may be mentioned: 1. That in every case of pregnancy more or less toxæmia exists, and that the blood intoxication becomes more profound toward the end of gestation. 2. That, although the eclamptic state is due to a toxæmia, the toxic agent which excites the convulsions is probably not always the same; there seems to be different types of the disease. 3. That the toxins may be produced in greater abundance in some cases (twin pregnancies), and that they are generally more virulent in primiparæ than in multiparæ. In the primipara mechanical pressure on the renal vessels may possibly come more into play, while in the multipara a certain degree of immunity against the toxin may have been acquired from previous pregnancies (Allbutt). 4. That in spite of very grave toxæmia no alarming symptoms will occur so long as elimination by the kidneys is sufficiently active. Of the nature of the toxins nothing is known, and there is no clear evidence to show where they are formed.

Lange noted that, out of 25 pregnancies in which the usual hypertrophy of the thyroid did not occur, albuminuria occurred in 20. Large doses of thyroïdin were administered to pregnant women in whom the physiological enlargement of the gland had occurred, and a marked diminution in the size of the gland resulted. One might therefore conclude that the normal hypertrophy of the thyroid gland in pregnancy is the result of a demand for extra secretion to meet the wants of increased metabolism. With a continuous supply of artificial secretion the gland was relieved of the additional strain and resumed its former size. Hallion observed

similar effects. H. O. Nicholson (Lancet, June 29, 1901).

Of all the theories advanced as to the cause of eclampsia and the pre-eclamptic state, none have appealed to us as strongly as that which takes into consideration urinary inadequacy, with the attendant diminution of the secretion of the solid elements of the urine. In other words, with an ever-increasing experience, we feel as morally sure as clinical experience will allow us that this dire condition is due to the poisoning of the system by urea or one of its congeners. S. Marx (Med. Examiner and Pract., March, 1903).

The idea that it is a renal disease seems to be abandoned, and it is now generally attributed to the circulation of poisons in the blood, either from the alimentary canal or due to metabolism in the body of the mother or of the fœtus, or of both. In health such poisons are either at once expelled from the body or rendered innocuous by its natural organs of defense,—the liver, kidneys, thyroid, and other glands,—but a breakdown of any one of these throws the whole mechanism out of gear. In most pregnant women the defensive power proves adequate; in some, though there is disturbance of function in early months, adjustment results and the symptoms of intoxication pass off; in a few the poisons accumulate, and eclampsia or other serious troubles result. Fothergill (Practitioner, Feb., 1903).

As in the course of more extended knowledge, the etiological factor of eclampsia was recognized as being associated with hydræmia of the blood and with toxæmia, not alone has the pressure theory been exploded, but so also have the vague and insufficient terms *uræmia* and *urinæmia* been discountenanced by the modern writer, teacher, and practitioner.

During pregnancy the blood alters both in quantity and quality. There is an increase in the white cells and a decrease in the red. Albumin and iron fall

below the normal. The blood becomes more watery, so to speak.

Careful histological studies made of the various organs in a large number of cases of puerperal eclampsia. In the vessels were found large multinucleated cells, which were considered to be cells derived from the placenta, and also multiple capillary thrombosis. From these facts the conclusion drawn that the disease is essentially due to the presence in the blood of a coagulating ferment formed either by the degeneration of the free placental cells found in the blood or by degenerative changes in the placenta itself. Schmorl (Virchow's Archiv; St. Louis Med. and Surg. Jour., May, '96).

Chamberlent, working under the direction of Tarnier, in 1892 performed a series of experiments on the blood of eclamptic women and published the following conclusions:—

1. Pregnancy tends to the retention of poisons in the body, for the urine of the pregnant woman is less poisonous than normal.

2. In eclampsia the elimination of physiological poisons is hindered, and the urine is less poisonous than normal. It is also less poisonous than the urine of normally pregnant women.

3. The blood-serum of the eclamptic is considerably more poisonous than normal, and its toxicity is in direct proportion to that of the urine.

The poison is by some believed to have its origin in the fœtus and placenta; but the commonly-accepted view is that the poison is of maternal origin from impaired metabolism, together with retention from impaired eliminative capacity of the kidneys.

The albuminuria of eclampsia is probably secondary, following the direct action of the poison on the renal epithelial cells, in the effort at elimination. Its almost universal presence in the eclamptic renders it a sign of some importance. Only about one-eighth of eclamptics subsequently develop nephritis, the albumin disappearing from the urine in from a few weeks to a few months after the attack, depending largely on the hygienic conditions which surround the patient.

While a patient with nephritis may and does sometimes have eclampsia, it is by no means the invariable rule. J. L. Rothrock (*Northwestern Lancet*, Nov. 15, '97).

That the blood-serum of eclamptics is more toxic than normal cannot be proved; but, on the contrary, the blood-serum of eclamptics produces, when injected into animals, the same symptoms caused by normal serum.

Both blood-serums produce dissolution of blood-corpuscles and hæmoglobinuria; both affect most powerfully when injected continuously. Volhard (*Monats. f. Geburts. u. Gynäk.*, B. 5, H. 5, '97).

Certain substances injected directly into the fœtus or the amnion are rapidly absorbed by the maternal organism, provided the fœtus is living, but much more rapidly from the fœtus than from the amnion. From this it would seem that the fœtus secretes certain toxic substances into the blood and amniotic fluid. Secondly, if the fœtus be dead, substances injected into either amnion or fœtus do not seem to pass into the maternal circulation. This would seem to throw considerable light upon the various phenomena of eclampsia, and especially as showing that the death of the fœtus is followed by cessation of the convulsive seizure. Baron and Castaigne (*Arch. de Méd. Expérimentale*, Sept., '98).

A large coccus, round or oval in shape, and of remarkable individual mobility, believed to have a definite connection with the etiology of the disease. Found in the blood of forty-four eclamptics. Lewinowitsch (*Centralb. f. Gynäk.*, No. 46, '99).

The systemic cell-activity in the pregnant woman is greatly increased. Excrementitious material accumulates rapidly in the system, and at any time the balance between secretion and excretion may become disturbed and a toxæmia or poisoning ensue. If this is apt to occur in a woman conceiving with normal or healthy excretory organs, all the more so is it likely to supervene in a woman who conceives in the presence

of an organic disease of one or another of the excretory organs—especially the kidneys. Thus then we may witness eclampsia develop during the pregnancy of a woman with kidneys diseased from the start or in women in whom possibly there has never been a suspicion of renal impairment.

Eclampsia is not common in women the subjects of chronic kidney disease before pregnancy; where kidney symptoms are present they usually develop suddenly; kidney-lesions may be absent; albuminuria is in many cases the effect and not the cause. The kidneys are not the only excretory organs whose failure to perform elimination properly may produce eclampsia. Ptomaine poisoning should not be forgotten. J. P. Boyd (*Albany Med. Annals*, Nov., '95).

Prognosis.—The prognosis in modern times has been greatly altered for the better. Whereas formerly the maternal mortality ranged about 30 per cent., nowadays there are series of cases recorded with as low a rate as 5 per cent. Some observers in a limited number of cases report no deaths. The fœtal mortality remains about 50 per cent.

In 52,328 cases of labor occurring within a period of 2 years there were 325 convulsions. The mortality was 19.38 per cent. Among 248 patients who survived the attacks, 54 subsequently developed other conditions; in 13 there were psychoses, generally ending in recovery; in 5 pneumonia, 3 pleurisy, and in 22 kidney trouble persisted. In 71.1 per cent. operative interference became necessary, including 108 forceps deliveries, 19 versions, 13 operations to lessen the size of the child, 2 induced abortions, and 7 Cæsarean sections. Löhlein (*Wiener medicin. Woch.*, Sept. 19, '91).

If the amount of urea in the blood is twice the normal, recovery is probable, while if it very nearly approach the physiological proportion the termination is generally fatal. This is also the case when the amount of the urea is five or six times the normal. More importance should be attached to the hepatic than

to the renal lesions. Butte (*Revue Méd. de l'Est*, May, '93).

Series of 5000 labors in which there were 50 cases of eclampsia,—42 in primiparæ. Twelve mothers died: 10 from eclampsia, 1 from nephritis, and 1 from sepsis. Geuer (*Centralb. f. Gynäk.*, No. 42, '94).

Maternal mortality in eclampsia, 30 per cent.; foetal mortality, 46.6 per cent. Tarnier (*Annual*, '96).

Series of 42,607 confinement cases 137—0.321 per cent.—of which suffered from eclampsia, 19 being already unconscious and many others having had many fits before being admitted to the clinic. Of the mothers, 109—79.5 per cent.—were primiparæ; 113 (97 I-paræ) were not more than 30 years old. One only had had eclampsia in a previous (first) confinement (IV-para; Cæsarean section). Twins are noted 12 times; hydrocephalus, hydramnion, and low lateral placenta, 1 each; abnormal rotation, twice; abnormal pelves, 9 times; 3 breech cases. The attacks commenced before labor in 16.78 per cent., during it in 62.04 per cent., and after delivery in 21.16 per cent. of the cases; and while 53.17 per cent. had less than 5 fits, the average number of fits in 126 was 8. Omitting the 34 children of 29 *post-partum* cases, of the remaining 115, 37—32.1 per cent.—were still-born, and 56—48.6 per cent.—were premature. In 50.7 per cent. of the whole, or 64.7 per cent. of the cases before delivery, emptying the uterus had a good effect. Of 27 deaths (19.7 per cent.), 17 only were due to eclampsia alone (12.4 per cent.). The mortality of multiparæ (6—21.4 per cent.) was greater than that of primiparæ (21—19.2 per cent.). The relative mortality of cases commencing before, during, or after childbirth was 30.43 per cent., 18.82 per cent., and 13.79 per cent. The proportion of deaths is comparatively low, and with the fact shown that delivery without too active interference tends to stop the fits is sufficient to warrant the adoption of conservative treatment for eclampsia. The practice of the Vienna clinic for many years has been a prophylactic milk diet for all albuminuric pregnant women; if this

fail, the induction of labor by bougie or colpeurynter. On the outbreak of eclampsia hot baths, linden-tea, wet packing, chloroform, and delivery as soon as may be without incisions. Schreiber (*Arch. f. Gyn.*, li, 335, '96).

Treatment.—The treatment of eclampsia may be considered to advantage under the following headings: (1) prophylactic; (2) medicinal; (3) surgical.

Prophylactic Treatment.—If the pregnant woman has been carefully watched by the medical attendant, only exceptionally will eclampsia develop, because the institution of certain prophylactic measures or early resort to certain surgical measures will nullify or prevent the development of certain phenomena which apparently underlie or enter into the causation. Thus, it is not sufficient, after a perfunctory fashion, to examine the urine for albumin, but the total amount passed and the amount of urea contained in it should be ascertained at intervals. Further still, explicit directions should be given in regard to the necessity of securing free action of the sudoriparous glands by means of frequent baths, and thorough action of the intestinal canal should be maintained. When the excretory organs of the body are acting physiologically those elements of tissue-waste which, retained in the body, favor the development of eclampsia, are excreted. When skin, bowels, and kidneys are clogged, the reverse holds true, and sooner or later, in pregnancy, symptoms appear which, if not properly appreciated and when possible eradicated, are forerunners of eclampsia. When urinalysis reveals the presence of kidney disease—whether organic or functional—steps should be taken at once to modify the symptomatology for the better by recourse to hygiene and dietetics, and, such measures failing, after reason-

able interval medicinal and surgical treatment enter the foreground.

The presence of albuminuria is undoubtedly of great value, but too many physicians trust to it alone, and the examinations are made only at long intervals. The medical man may usually feel secure so long as the ureal elimination is near the normal,—400 or 500 grains per diem; but this is not, alone, an absolutely reliable guide. A most important and neglected element in the prognosis is the daily quantity of urine. If every pregnant woman were taught to measure the urine once or twice weekly during the later months of pregnancy, and impressed with the necessity of keeping it at or above three pints per day, convulsions in childbed would be almost unknown. C. Jewett (Brooklyn Med. Jour., Aug., '99).

Chief among the hygienic measures stand hot baths and gentle catharsis; foremost among the dietetic measures ranks milk diet (associated with the administration of an assimilable and non-astringent form of iron).

Milk treatment is most efficient from a prophylactic point of view, though it does not necessarily cause the other alarming symptoms, besides the fits, to vanish. The alleged disappearance of albuminuria does not necessarily occur, even after prolonged treatment by milk diet. The same may be said of the œdema; this treatment seems to have no effect on it. The above facts are emphasized, because some obstetricians have very naturally given up milk diet on account of persistence of albuminuria and œdema. Such a step is a mistake, for, if the treatment be continued, labor will proceed without any fits coming on, though the legs remain swelled and the urine albuminous. Ferré (*L'Obstétrique*, Nov. 15, '96).

Analysis of 48 cases. The uterine douche alone was sufficient to check the infective process in 15 cases. Exploration and curettage of the uterus were followed by a rapid fall of temperature in 8 cases, a gradual fall in 10 cases, a temporary increase followed by a rapid fall

in 2 cases, and no effect on the temperature in 13 cases. A. W. W. Lea (*Med. Chronicle*, Aug., '99).

There are three main channels through which toxic substances may be got rid of, viz.: the bowels, the skin, and the kidneys. In eclampsia the urinary system is chiefly at fault, but the two other channels must not be neglected. Hot pack or bath to produce free action of the skin, with enemata to promote elimination of toxins by the bowels, and, to get the kidneys to act, large saline injections are advocated. The solution used was 1 part of bicarbonate of potash to 1 of common salt: 1 drachm to the pint of sterilized water at 100° F. The bicarbonate of potash is added to obtain the diuretic action of the potash salts. The apparatus used is an aspirator trocar and cannula, a few feet of rubber tubing, a test-tube-shaped filler, and a piece of adhesive plaster. The injection is made conveniently under the edge of the breast before delivery; the lax abdominal wall, after delivery. From 1 to 4 pints may be employed. Absorption begins at once, and is complete in fifteen or twenty minutes. In seventeen cases saline injections were employed to increase the flow of urine, and so aid elimination by the kidneys. Analysis showed a marked increase in the daily excretion of urea and uric acid, and there is probably a corresponding increase in the excretion of the poison which causes the disease. Jardine (*Practitioner*, Dec., '99).

Where, notwithstanding these measures, the evidences of organic kidney disease become intensified, or where, these evidences lacking, the symptoms suggestive of impending eclampsia develop, time for action has come, justifiable delay having reached its limit. In the past and even to-day expectancy has been and is too often the cause of untoward results.

With the exception of the fulminating type of eclampsia—where art almost always fails, it may be stated that prompt action, of the nature to be described, will,

in the vast proportion of cases, prevent the development of eclampsia.

Medicinal Treatment.—In the presence of the prodromal symptoms of eclampsia, but little reliance can be placed on drugs. Where urinary insufficiency exists, indeed, it is very questionable if the routine administration of drugs do not harm. Certainly the potassium salts are very likely to irritate the kidneys. The ingestion of large amounts of water by mouth and repeated introduction of warm normal saline solution into the blood-stream will accomplish more than any and all drugs together.

The treatment of eclampsia should be, in the first place, prophylactic. A careful examination of the urine at short intervals in the late months of pregnancy, together with a careful watch for the first evidence of toxæmia, should be the duty of everyone who undertakes the care of these cases.

Van Renssalaer suggests venesection, carried to the point of tolerance, and then followed by the subcutaneous injection of a normal salt solution. This method need not be confined to the plethoric, but even a weak pulse and profound coma do not contra-indicate its use, for the rapid introduction of the warm salt solution following venesection counteracts the effects of bleeding, filling the vessels and stimulating the heart. From a pint to a quart of blood can be safely withdrawn from the veins of a patient of average weight, providing the injection of the salt solution is followed up at once. J. L. Rothrock (*Northwestern Lancet*, Nov. 15, '97).

In eclampsia the supporting rather than the stimulant treatment favored. Venesection followed by infusion is the ideal treatment for the casting off of the toxins with which the blood is crowded, and the most efficient way of supporting the patient. Salt infusion alone is but a partial remedy. G. J. Engelmann (*Boston Med. and Surg. Jour.*, Nov. 9, '99).

Series of cases of puerperal eclampsia treated by rest, pure milk diet, injec-

tions of morphine to control convulsions, and the regular administration of thyroid extract in doses of 0.30 gramme (5 grains), repeated, if necessary, every three or four hours. The symptoms, especially headache, albumin in the urine, œdema, amblyopia, etc., began and steadily continued to disappear. Thyroid extract is also of value to prevent convulsions in women who give a history of eclamptic seizures during previous pregnancies. H. O. Nicholson (*La Semaine Médicale*, May 21, 1902).

As regards treatment in the early stages, when there are increased tension of pulse and diminution of urine thyroid extract should be given twice or thrice daily, and proteid foods should be entirely forbidden at first. Iodide of potassium in small doses has been regarded as a specific for puerperal albuminuria; the iodine has been proved to be picked out by the thyroid gland and may be elaborated into the active iodothyron. It has been suggested to give infusions with iodide of potassium instead of ordinary saline infusions in cases of eclampsia. If convulsions have already occurred, then the use of thyroïdin by the mouth will not be rapid enough. *Liquor thyroïdii*, or, better still, fresh thyroid juice, from 10 to 15 minims, should be given by hypodermic injection and repeated every hour or two if not followed by signs of improvement. For the immediate treatment of the convulsion morphine is the best remedy. It inhibits the various processes of metabolism, and this gives opportunity to the thyroid gland to recover itself. The dose should be large: not less than $\frac{1}{2}$ grain for the first injection. H. O. Nicholson (*Lancet*, June 29, 1901).

Intravascular antiseptics appeals to the mind of every scientific observer of septic conditions of the blood. An intravascular antiseptic or germicide must be destructive to bacteria and at the same time not injure the patient. Formaldehyde possesses this specific influence, as shown by experiments on animals. Maguire used solutions upon himself as strong as 1 to 500 without any hæmolytic changes. Case of septi-

cæmia personally treated with success by formalin injections, using an aqueous solution, 1 to 5000. Formalin in normal salt solution would be better than aqueous solution, although no hæmoly-sis follows the infusion of formalin in distilled water. Theoretically, however, salt solution is preferable. Barrows (New York Medical Journal, Jan. 31, 1903).

The saline irrigation—if a number of quarts are used at a time—promotes diuresis and diaphoresis and indirectly enforces intestinal peristalsis, and such irrigation should become the established custom not alone in face of impending eclampsia, but also in the presence of eclampsia. Where the pulse of tension exists venesection—too seldom resorted to nowadays—is called for.

Saline transfusion should be resorted to if the patient is in a collapse and death seems imminent. These hypodermic injections of warm sterilized water, salt (1 per cent.), to the amount of one-half pint, into the vascular tissues of the axillæ will be readily absorbed. G. Covert (Chicago Medical Times, Apr., '98).

Inasmuch as eclampsia is undoubtedly a toxæmia, one should look for good results from the intracellular transfusion of saline solution. Bacon's apparatus consists of a glass funnel and long rubber tube, which is connected by means of a Y-shaped glass tube and two short rubber tubes with two aspirator needles. The solution can be injected into the two axillæ at the same time, and thus the main objection against the intracellular contrasted with the intravenous method may be in great part obviated. Edgar (Glasgow Med. Jour., Apr., '99).

Three cases of eclampsia treated by saline infusion. As soon as the patient rouses sufficiently, drachm doses of Epsom salts every hour are given. The salt solution usually acts wonderfully in stimulating the kidneys; but, if necessary, dry and wet cups may be used with $\frac{1}{2}$ ounce of infusion of digitalis every four hours. The diet is exclusively

milk. To stimulate the skin, the hot-air bath or the wet pack is used. Tonics are given during convalescence. Allen (Amer. Jour. of Obstet., May, '99).

The experiments of Tarnier, Ludwig, and Savor certainly show that the toxicity of the blood-serum is increased in eclampsia, while, on the other hand, those of Charrin and Volhard seem to prove just as conclusively that it is not. In treatment, prophylaxis stands pre-eminent. When the trouble has developed the treatment may be summed up in one word, "elimination," and nothing will give such immediate results as bloodletting, followed by infusion or transfusion of saline solution. If the patient be anæmic, do not bleed, but use the saline injection. The results of such treatment observed to the effect that: (1) the patient's general condition will improve; (2) the cyanosis, muscular twitching, and rigidity will have ceased; (3) the pulse, which before was hard and bounding, will have lost its tenseness, and the attendant coma, be it never so deep, will slowly, but surely, be lifted. The writer says, in conclusion, that if bloodletting, together with saline infusion or transfusion, were more generally employed, better results would be obtained in the treatment. E. T. Abrams (Amer. Jour. of Obstetrics, Jan., 1903).

Possibly veratrum viride administered hypodermically every two or three hours in the dosage of 10 minims, until the pulse-rate is materially lowered (down to 60 or 40) will accomplish the same result as venesection, and at times the free use of this drug will render unnecessary resort to active surgery, except where the symptoms are very urgent, when we are amply satisfied that dallying with drugs should cease.

Twenty-six cases with no deaths treated with veratrum viride by the mouth or subcutaneously until pulse had been lowered below 60 and convulsions controlled, after which the following mixture given:—

R. Acidi benzoici, 2 drachms.
 Potass. bicarb., $\frac{1}{2}$ ounce.
 Spirit. æther. nit., 1 ounce.
 Spirit. Mindereri, 2 ounces.
 Syr. limonis, q. s. ad 6 ounces.

M. Sig.: A teaspoonful every four hours. R. C. Newton (N. Y. Med. Jour., Dec. 14, '95).

The toxins causing uræmia are varied and numerous. In eclamptics the urine is less toxic than normal, while the blood-serum is more toxic. The fœtus is an additional source of waste-products and an additional cause of danger to the mother. The indications for treatment are to remove the toxic materials in every way practicable. *Veratrum viride* in cases where the pulse is strong enough to warrant its employment will be found useful. The depressing action of pilocarpine makes it a dangerous drug. Many patients with eclampsia die from over-medication. Labor should be induced or delivery hastened when other methods fail to control the convulsions. P. W. Van Peyma (N. Y. Med. Jour., Feb. 22, '96).

The method by which *veratrum viride* is supposed to do good in cases of puerperal eclampsia is a double one. Chiefly from the action of its alkaloid, jervine, it powerfully depresses the circulation, and so bleeds the woman into her own vessels, relieving by this means congestion of the cerebral and spinal vessels and reducing in all probability any spasm of the renal blood-vessels which may be present, thereby causing marked increase in the flow of urine. In addition to this action, jervine also acts as a powerful sedative to the motor tracts of the spinal cord, and so directly quiets nervous excitation, while the copious sweating which often follows its administration aids in relieving the blood of impurities, the kidneys of congestion, and relaxes the peripheral blood-vessels. Editorial (Therap. Gaz., Mar. 16, '96).

Veratrum viride used with marked success. The remedy notably diminishes the frequency of the pulse, and convulsions rarely occur when the pulse is kept at or below 60. Of 100 patients treated by *veratrum viride* in the

writer's practice, 92 were saved. Parvin (Universal Med. Jour., Oct., '96).

During the attack itself chloroform administered. As soon as the attack passes, 15 drops of the fluid extract of *veratrum viride* are given hypodermically, and a drachm of chloral in solution by enema. Two drops of croton-oil diluted with a little sweet oil are placed upon the tongue. Diaphoresis is induced by hot packs and extra bed-clothing. A pint or more of decinormal salt solution should be injected by gravity under the breast, or several quarts of the solution by enema. If convulsions recur, the *veratrum* may be repeated in 5-drop doses if the pulse is quick and strong. If the face is congested and the pulse full, venesection enough to reduce the pulse should be employed. The chloral may be repeated during the attack two or three times. Stimulants are to be used if the pulse is weak and rapid. If the convulsions cease and the patient is in a stupor, but can be aroused enough to swallow, dessertspoonfuls of concentrated solution of Epsom salts should be given every fifteen or thirty minutes until free catharsis takes place. B. C. Hirst (Med. Record, Mar. 4, '99).

In five personal cases of eclampsia there was not a single convulsion after ether had been thoroughly given, though in these cases many convulsions had followed other lines of treatment. The harmlessness of continuous and thorough anæsthesia is emphasized. In the five cases anæsthesia was kept up from eight to twenty-four hours, deeply enough to keep the patient quiet, and there was not a single symptom that showed that any of the women was any the worse for the anæsthetic. J. P. Reynolds (Boston Med. and Surg. Jour., Nov. 9, '99).

Veratrum viride is the remedy par excellence in eclampsia, acting to reduce arterial tension and to soften the rigid os, thereby removing the causes producing the malady. F. L. Brigham (Amer. Gynæc. and Obstet. Jour., Dec., '99).

Nitroglycerin, in the dosage of $\frac{1}{16}$ grain, hypodermically, repeated *pro re*

nata will tend to relieve the cephalalgia. When the convulsions appear suddenly morphine, 1 grain hypodermically, is called for until chloroform anæsthesia to the surgical degree is secured; but otherwise opium and its derivatives should not be countenanced, because of their tendency to inhibit secretion from the intestinal canal and from the kidneys, thus defeating the prime therapeutic aim, which is to increase secretion and excretion.

Case of puerperal infection treated by Marmorek's antistreptococcic serum with very successful results. Other drugs were used with no beneficial effects; but, upon beginning the serum-treatment, improvement was steady and rapid, and four days after the first injection the temperature was normal. R. de Seigneaux (Centralb. f. Gynäk., Dec. 16, '99).

The pathological features and symptoms that require treatment are: The toxæmia, anæmia, the convulsions, the labor-pains, hypersensitiveness of the nervous system, to avoid causing œdema of the lungs, heart-failure, and high-tension pulse.

For the toxæmia, elimination by purgation with calomel, accompanied by magnesium sulphate in $\frac{1}{2}$ -ounce doses of the saturated solution. In antepartum cases this purgation, with an occasional dose of calomel, must be kept up until the child is born. One of personal cases carried on in this way after the patient had had eight convulsions for seven weeks, when a healthy child was born, and thrived. In 2 cases it happened that when the morning course of salines was omitted, owing to the bowels having moved early in the morning, convulsions came on again at night. In 1 of them, after the patient had been kept free from convulsions for a week. In case of unconsciousness, 2 minims of croton-oil may be introduced through a stomach-tube.

Normal saline solution given subcutaneously acts very well as a diuretic. K. C. McIlwraith (Canadian Pract. and Rev., June, 1901).

The serum-treatment has no place in

the routine treatment of puerperal sepsis; it should be used only in desperate cases after failure to obtain improvement by other and usually more efficient methods, and if no improvement is shown after use for two or at most three days and the injection of 40 to 60 cubic centimetres (10 to 15 fluidrachms), it should be discontinued. Its use is not free from danger, it usually lowers the pulse and temperature, but at the same time it has a correspondingly depressing effect upon the patient, and it has not apparently lowered the mortality of the disease.

With regard to the general treatment of puerperal sepsis, early curettage of the uterus carefully performed as soon as the diagnosis is established is of primary importance, and the same result is not accomplished by any other method of procedure. Following curettage, and sometimes in place of it in the mild cases, intra-uterine douches have proved to be of much value. For constitutional treatment, one must mainly rely on stimulation, tonics, and forced feeding, with moderate diuresis and catharsis. F. A. Higgins (Boston Med. and Surg. Jour., May 2, 1901).

These few drugs failing to control the premonitory symptoms or eclampsia suddenly developing, measures of a surgical nature are called for.

Surgical Treatment.—Where the symptoms which forebode the development of eclampsia do not yield to the dietetic, hygienic, and medicinal treatment outlined, the surgical measure demanded is evacuation of the uterus.

In eclampsia occurring during parturition delivery should be effected as quickly as possible under deep anæsthesia. When possible, without loss of time, the cervix should be widened by hydrostatic dilators, and the smallest possible incision. When the condition of the cervix is the cause of delay after artificial dilatation, incision as deep as may be necessary should be made. Hæmorrhage arising from this cause may be controlled by tampons of gauze or by pressure-forceps. In such cases,

considering the amount of hæmorrhage from the incision, there can never be any question of adopting venesection. When the patient is unconscious, no attempt should be made to make her swallow; a suitable stomach-pump should be invariably used for the introduction of nourishment or medicine. Anæsthetics should be used to the surgical extent only during the operation of emptying the uterus, and either chloroform or ether may be used. The most exact asepsis is required; infection prolongs the convulsion stage of eclampsia. P. Zweifel (Centralb. f. Gynäk., Nos. 46 to 48, '95).

In the Prague hospital the rule is to deliver as rapidly as possible consistent with avoiding injury. A mixture of chloroform, ether, and alcohol is an especially safe preparation, the anæsthetic being administered not only during the operative proceedings, but also to modify the convulsions. Morphine is also constantly employed. The prolonged warm bath and the hot wet pack are very important. The only beverage permitted is lukewarm milk. Knapp (Monats. f. Geburts. u. Gynäk., B. 3, May and June, '96).

Albuminuria is a premonitory sign too important to be overlooked. Termination of the delivery is in all cases desirable, and it *must* be rapidly brought about in serious cases. Therefore from the beginning of the attacks we must act continuously in that direction. In very urgent circumstances we must not hesitate to dilate the cervix. If this *accouchement forcé* is difficult, too slow, or impossible without too much injury, we must have recourse to Cæsarean section. N. Charles (Jour. d'Accouchements, Oct. 11, '96).

In puerperal eclampsia the chief aim is to empty the uterus of its contents as quickly as possible. The cervical canal should be dilated, first by means of Hegar's graduated sounds and afterward with the fingers, until the orifice has attained a diameter of three centimetres. Podalic version, according to the Braxton-Hicks method, is then practiced and one foot extracted. This done, the uterine orifice is again dilated by separating

its edges on one side by means of the child's leg, upon which the hand of the operator exerts (the foot being already extracted from the wound) energetic lateral pressure, and on the opposite side with the hooked index of the other hand. When dilatation of from eight to ten centimetres has thus been obtained, it only remains to extract the child. As soon as the umbilical cord has been severed the placenta should be detached and the uterus compressed with the two hands for about an hour; this compression suscitates the uterine contractions, preventing any serious hæmorrhage. Drejer (Sem. Méd., Oct. 31, '96).

Acceleration of labor by safe methods, large doses of morphine to suppress the attacks, avoidance of administering medicine by the mouth, stimulation of diaphoresis by external remedies—all these appear to promise most success in treatment. Veit (Festschrift f. Carl Ruge, '96).

Whenever albumin is discovered in the urine of a pregnant woman, she should, without delay, be put upon a strict milk diet, for albuminuria is to be regarded as a symptom of the state of autointoxication which results in eclampsia. Tarnier says that he has never seen eclampsia supervene in pregnant women suffering from albuminuria who have been for seven days upon a strict milk diet. During the convulsions the tongue is best preserved from injury by placing a folded handkerchief between the teeth, which pushes the tongue back, and also prevents the teeth from closing. The patient should be placed immediately under the influence of chloroform. A rectal injection of about 60 grains of chloral should next be given; it is advisable to begin with a large dose rather than repeated small doses. If necessary the injection of chloral may be repeated several times, giving as much as 250 to 300 grains in twenty-four hours. The inhalation of chloroform should be continued during the attacks. Bleeding is reserved for the rare cases which are distinctly "sthenic" in type. As a diuretic agent, half a pint or more of a saline solution containing 1 per cent. of chloride of sodium, may be injected into the buttock, and the injection repeated sev-

eral times. No interference is required until the cervix is fully dilated, when the child may be extracted with forceps or by turning. Delivery by such forcible methods as rapid dilatation or incision of the cervix is condemned. Oui (L'Echo Méd. du Nord, May, '97).

The treatment consists in controlling the convulsions by *profound narcosis*, speedy evacuation of the uterine contents, and diaphoresis, with a view to re-establish skin function and reduce the tension. Kedarnath Dass (Indian Med. Record, April 16, '98).

The nearer the term, the easier the procedure of emptying the uterus; the same statement applies to the multipara over the primipara. The steps of the procedure are, in brief, the following: Under the most absolute asepsis of patient, instruments, and hands of operator and assistants, ordinarily under chloroform anæsthesia, the cervix is dilated by the steel-branched or other dilator. Great care is requisite not to rupture the membranes. The cervical canal is then firmly packed with sterile gauze, and the upper portion of the vagina as well. The woman is put to bed and if she complain of much pain codeine should be used freely in suppository (gr. ii to iv repeated every four to six hours), for reflex nervous irritability must be controlled. At the expiration of about twenty-four hours, under absolute asepsis and chloroform anæsthesia, the gauze is removed, and, if the cervix has softened and is dilatable, manual dilatation is resorted to. If the cervix has not softened and the symptoms are not urgent the canal should be repacked for a further period of about twenty-four hours. Dilatation by the hand having been accomplished to the requisite degree—that is to say, until the closed fist can be withdrawn with ease, the membranes being intact, elective version is performed, followed by immediate extraction, else the lower uterine

segment may close on the foetal head. When the membranes have ruptured delivery from the brim by axis-traction forceps is indicated. After delivery—when the pulse is full, strong, bounding—uterine venesection is allowable until the pulse becomes soft. Where, on the other hand, the pulse after delivery is rapid and weak, no time should be lost in the thorough uterine tamponade.

Where eclampsia develops without premonitory symptoms, or where delay with the premonitory symptoms has ruled, there is no time for the preliminary tamponade. Under absolute asepsis and chloroform anæsthesia manual dilatation is at at once instituted, associated, in very rare instances, with the Dührssen incisions, the uterus being then emptied.

In post-partum eclampsia there is no scope for surgery, and dependence must rest on drugs (veratrum and the nitrites), on repeated high saline rectal irrigation, and in free catharsis, using elaterium or croton-oil. Whether the case be of the sthenic or asthenic type, these rules hold good, except that in the latter type hypodermoclysis of saline solution should be added, and in the latter venesection.

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ECZEMA.—Gr., *ἐκζεῖν*, to boil over.

Definition.—Eczema may either be an acute, subacute, or chronic inflammatory disease of the skin, usually characterized in its earliest stages by the appearances of erythema, papules, vesicles, or pustules, or a combination of two or more of these lesions. It is attended with a variable degree of thickening and infiltration of the cutaneous tissues, terminating either in discharge with the formation of crusts or in absorption or in desquamation.

Varieties.—The primary, or elementary, varieties are the erythematous, papular, vesicular, and pustular; or the first

outbreak may show a mixture of these several types. In many cases the beginning lesions or type soon lose their characters and the disease develops into the common clinical varieties: eczema rubrum or eczema squamosum. Other clinical or secondary types met with are eczema fissum, eczema sclerosum, and eczema verrucosum.

Symptoms.—The *erythematous* type of eczema—also called eczema erythematosum—is most frequently seen upon the face, although it may make its appearance upon any other region or may be more or less general. It begins as a single hyperæmic area, or several areas may appear simultaneously, usually upon one region. The areas may be small or large, irregularly outlined, ill defined, and attended with slight or considerable swelling and even œdema. There is more or less itching and burning. The eruption soon becomes pronounced, the parts reddened, somewhat thickened, and here and there a little scaly. There may also be, here and there (as a result of rubbing or scratching, or spontaneously) a tendency to serous oozing. The affected skin is harsh, dry, and reddish or violaceous in color. It often persists in this form, and the skin may become considerably thickened and infiltrated. The swelling and œdema which are often first present may subside, to a great extent at least, or these symptoms may reappear from time to time whenever there is an acute exacerbation. The parts may become quite scaly, and constitute a mild or well-marked scaly eczema: eczema squamosum. Occasionally, as a result of constant irritation, rubbing, and scratching, or from other causes, the parts become moist, markedly inflamed, with more or less crusting, constituting eczema rubrum.

The *papular* type of the disease, or eczema papulosum, presents itself as one or more aggregations of closely-set papules, pin-point to pin-head, or slightly larger, in size. The disease may also show itself as more or less discrete papules, with here and there aggregations. In color the lesions are bright- or deep- red or violaceous, with often a few vesicles or pustules interspersed. Itching is usually intense. The extremities, and the parts, especially about the joints, are its favorite sites. The course of this type is essentially chronic, some lesions disappearing and others appearing, and thus persisting for several months or indefinitely. In some instances, especially in some areas, the papules become so thickly crowded that a solid patch results, becoming more or less scaly—eczema squamosum. Or at times such a patch may develop into eczema rubrum.

The *vesicular* type of the disease, or eczema vesiculosum, may show itself on one or more regions, and consists of aggregated or closely-crowded pin-point to pea-sized vesicles, with here and there discrete lesions, and at times with papules and pustules interspersed. It is usually a markedly-inflammatory type, with considerable œdema and swelling. Solid sheets of eruption may form. The vesicles usually rupture in the course of a few hours or days, new outbreaks occurring, or a raw weeping, more or less crusted surface resulting. The oozing may be continuous or the process may decline, to remain quiescent or to break forth rapidly with repeated vesicular crops. Considerable thickening may take place and with the oozing and crusting make up a picture of the common clinical type: eczema rubrum. The face and scalp of infants, the neck, flexor surfaces and fingers are the more common sites for the vesicular type. Its course is

usually chronic, with several acute exacerbations, or, as already described, it may pass sooner or later into the common clinical type: *eczema rubrum*.

The *pustular* variety of eczema, or *eczema pustulosum* or *impetiginosum*, is less frequently met with than the other varieties of the disease. Its common site is the scalp, especially in infants. It may develop from the vesicular variety, or, as more commonly the case, begin as closely-set pin-point to pin-head, or larger sized pustules; or a mixture of vesicles and pustules may be noticed. In symptomatology it is similar to *eczema vesiculosum*, except that the lesions, instead of containing serum, contain pus. As in the vesicular type, the same disposition to the rupture of the pustules is observed, and there is often a tendency to develop into the type known as *eczema rubrum*. More or less crusting is usually a conspicuous feature. The ill-nourished and strumous persons are its most common subjects. The type is essentially chronic.

The *squamous* type of eczema, or *eczema squamosum*, is a clinical variety frequently met with, characterized by redness, infiltration, and more or less scaliness, with, especially when about the joints, more or less fissuring. The itching is variable, sometimes intense, and at other times slight. This variety is usually a development from the erythematous or papular types, and, like other types of the disease, is persistent and chronic.

Eczema rubrum, the oozing type of eczema, or somewhat dry, raw-looking type of eczema, usually results from a pre-existing vesicular or pustular eczema. It is characterized by a red, weeping, oozing, raw-looking surface, with more or less infiltration of the cutaneous tissues. In some cases there is a combination of

weeping raw surface with crusted areas. In other cases the weeping nature of the disease is a conspicuous feature, crusting scarcely having time to form: *eczema madidans*. Its most frequent sites are the face and scalp of children and the legs of adults; in the latter in those especially advancing in years. In these cases of eczema of the lower legs varicose veins are often present as a precursory and concomitant condition. It is essentially chronic, showing little, if any, disposition to disappear spontaneously, although it may be somewhat variable. The degree of inflammation varies from time to time.

The *fissured* type of eczema, or *eczema fissum* or *eczema rimosum*, is that type of eczema in which cracking or fissuring of the skin is the most conspicuous feature. It is common about the joints, especially about the fingers, and in most cases is a part of an apparently slight erythematous eczema. Fissuring may occur in any type of the disease, especially when about the joints; but in most cases it is but slight in character. It is a persistent type of the disease, usually disappearing in part or more or less completely in warm weather. A somewhat analogous or allied variety of eczema is the so-called crackled eczema. This is usually a mild subacute erythematous eczema, involving large regions or the entire surface, numerous superficial cracks through the upper epiderm showing over the fissured surface.

Eczema sclerosum and *eczema verrucosum* are somewhat rare varieties of the disease. These types are usually seen about the ankles, lower leg, or feet. They commonly result from a pre-existing papular eczema. In many respects these types are analogous in their symptomatology: there is considerable thickening and board-like hardness, with, as a rule,

much infiltration, but with the inflammatory element slight or comparatively so. The surface is rough, hard, and somewhat horny to the feel, and in the verrucous variety there is added to these several symptoms a variable degree of papillary hypertrophy, the surface having a distinctly-warty appearance. Both types are essentially chronic and rebellious to treatment, demanding the strongest application.

Infantile Eczema.—The disease is common in infants and young children. It is unusual, comparatively speaking, in children past the age of 6. Even in those cases in which the disease begins in the first or second year and is persistent, it tends to decline spontaneously toward the age of 5 or 6, or even earlier; or at least at this period it will usually respond rapidly to any mild or indifferent application. The disease presents no special characteristics in the young, except that in the majority of such cases the inflammatory element is apt to be more marked. In by far the larger proportion of cases the face or the face and scalp are the seat of the disease; eczema of the region of the genitalia and anal cleft is also not infrequent.

All cases of infantile eczema will usually do well under treatment, although a disposition in many cases is shown toward relapse till the age of 4 to 6 is reached.

In eczema in infants and young children occurring about the legs and arms, usually as a vesico-papular or papular eruption, discrete and patchy, the disease is often obstinate,—much more so, as a rule, than in those cases where the disease is limited to the face or face and scalp. The vesicular, vesicular-papular, and moist or crusted inflammatory type—eczema rubrum—seem most frequent in the young.

Regional Eczema.—It is usual to describe eczema as it appears upon different regions, as, for instance, the hands, face, scrotum, legs, etc.; but the disease in reality differs little, certainly not materially, as it occurs upon different parts. The description of the several types of the disease as already given suffices.

It is noted that the most common seats for eczema in those of the active age, between 21 and 50, is about the hands, less frequently about the face or the scalp; the scrotum is not an uncommon site, and also the anal region.

There is a remarkably-obstinate form of chronic eczema, which attacks the palms, and, though more rarely, the soles sometimes also. The disease commonly takes its origin in the centre of one palm, though it is generally not long until both are implicated. There are hard, scaly patches of infiltrated skin, involving more or less of the surface; there is ragged and uneven scaling, while in the natural lines of flexion, or independent of these, are deep and painful cracks. The hands feel hot, and burn and itch at times. This morbid condition advances sometimes along the fingers toward their tips, the pulp remaining, as a rule, immune. A symptom observed in the feet which is not so evident on the palms is the existence of a band of congestion beyond the scaly area, fading imperceptibly into the natural tint of sound skin. Though met with in both sexes, this variety of eczema is most commonly encountered in women, and in them about the menopause. Jamieson (*Edinburgh Med. Jour.*, Jan., '98).

In a recent analysis of 10,000 miscellaneous skin cases in the writer's private practice, 32.01 per cent. suffered with eczema. Neurotic eczema is frequently observed in infancy, in connection with cutting of the teeth; in childhood it is less common; its most frequent time of occurrence is between 20 and 55 years of age. Various forms or phases of nerve disturbance are seen in connection with neurotic eczema, and

they may be considered under the following heads: (1) neurasthenia, or nerve-exhaustion; (2) nervous and mental shock; (3) reflex phenomena (a) of internal origin or (b) peripheral; (4) neuroses, (a) structural or (b) functional.

The eruption is apt to come first upon the hands and face, less commonly on the feet. But from its starting-point it may extend over large surfaces. Neurotic eczema upon the hands is very apt to exhibit vesicles; but on the adult face the eruption is quite as likely to assume and maintain the erythematous form, with vesicles, and often without moisture, unless scratched. The groups of lesions have a tendency to be pretty sharply defined, in more or less herpetic patches, which may present mainly solid papules, or, when torn, a raw surface. It is intensely itchy, and the spasms of itching are sometimes fearful and utterly uncontrollable. L. Duncan Bulkley (*Jour. Amer. Med. Assoc.*, Apr. 16, '98).

In eczema about the finger-nails the matrix or the bed of the nail may be affected, primarily, or by contiguity from eczema on the back of the finger. The first sign is the redness of the supra-ungual tissue, which becomes painful to pressure. Rarely, so much serum may exude that the nail is lifted up, and finally falls off. Striations are noted in the nails, with punctiform depressions. The whole nail may be raised from its bed or a depression may appear in the median line. If the eczema is chronic the nails will be deformed. W. Dubreuilh and D. Freche (*Jour. de Méd. de Bordeaux*, Apr. 14, 1901).

In those past the age of 50 the most common site is the lower leg, although eczema of the face is not infrequently met with.

General Symptomatology.—The subjective symptoms in eczema are itching, burning, and a sensation of heat. These may be severally present, or, as is more commonly the case, one is predominant. The degree varies, sometimes slight and

at other times almost unbearable. As a rule, there are no constitutional symptoms so-called in eczema cases. In extensive general acute eczema there may be slight febrile action and sometimes slight chilliness at the outbreak of the attack. The degree of inflammatory actions varies in the same case from time to time and in different cases. The disease may be acute both in type and its course, running to an end in several weeks or one or two months. As a rule, however, whatever the type of the inflammatory process—acute, subacute, or chronic—the disease is persistent and long-continued, with, in most cases, little, if any, tendency to disappear spontaneously. Seasons often have an influence, the disease usually being less active or partly or completely disappearing in the summer weather. On the other hand, there are cases of the disease met with that are at their worst in summer time, and frequently disappear in the colder weather; such instances are, however, exceptional.

Etiology.—The consensus of opinion points to both external and constitutional causes as active factors in most cases of the disease. The possibility and even probability of this disease's being due to a parasite is more or less seriously entertained in some quarters.

In eczema the staphylococcus aureus present in practically pure culture in a large series of examined cases and invaded the deeper layers of the skin. Eczema may therefore be considered to be due to a staphylococcic infection. W. Scholtz (*Deutsche med. Woch.*, July 26, 1900).

In some ordinary forms of eczema efflorescences appear which contain no micro-organisms or some the pathogenic nature of which is not demonstrable. In such cases the etiology depends probably upon mechanical or chemical irritation. In other cases ordinary streptococci or

staphylococci are seen which can be observed at any time in any portion of the healthy skin. These bacteria, invading the skin where there is an eczema, may arouse additional inflammation, the severity of which depends upon the patient's idiosyncrasy and the virulence of the germs. Jadassohn (Wiener med. Blätter, Aug. 23, 1900).

Bacteriological studies of 74 cases of this disease showed 23 types of coccus. Absolutely typical eczematous lesions were produced by two of these: the *diclimactericus eczematissimus albus flavens* and *monoclimactericus eczematissimus vivens*, while a third strongly suspicious form might be called *trichimactericus eczematissimus tenuis*. P. G. Unna (Wiener klin. Rund., Sept. 16, 1900).

Gilchrist and Sabouraud have noted the frequency with which streptococci occur in skin lesions. Personal method by which it was possible to detect small numbers of this organism. Sabouraud's medium is used and inoculated by means of a long capillary tube from which the fluids or crusts to be investigated are aspirated. In more than 100 cases it was possible to detect staphylococci in 53.7 per cent.; 27 of these cases were eczema, and in these streptococci were present 17 times. In order to determine in what proportion of normal skins streptococci were present, 160 areas in 55 human beings were studied, and streptococci were found in 7.5 per cent. They are most frequent in the axilla and on the back. These streptococci resemble exactly those found in skin lesions. The artificial forms of dermatitis are sometimes sterile, and sometimes bacteria in considerable numbers can be obtained from them. In the histological appearance, however, there are some differences between the two forms. In view of the extreme obscurity of this subject, it is important to study all cases of eczema in two directions: first, as to whether there is any internal condition that may produce them, and, second, the possibility of some external irritant. Frederie (Münchener med. Wochen., No. 38, 1901).

Among the constitutional influences which are or seem to be of some importance as predisposing or active factors are gout, rheumatism, disorders of digestion or assimilation, dentition, struma, general debility, and loss of nervous tone.

The chief elements of causation in the eczema of elderly people seem to be a debility of tissue and a faulty kidney-action. The urine is scanty and of high specific gravity, and often loaded with urates. Sugar is not uncommon. Deficient bowel-action is likewise common. These facts give a basis for treatment. Local measures will not be successful if these points are not carefully attended to. Bulkley (Trans. Med. Soc., State of N. Y., '90).

Importance of the vital relations of the cell-protoplasm in the epithelial cells, and of the cellular secretions or excretions in destroying noxious agencies, on the one hand, and promoting the health of the tissues, on the other, are in danger of being overlooked, in consequence of the long discussions which take place concerning the bacteriology of eczema, many of which are unsupported by exact observations or bacteriological research of any sort. Leslie Roberts (Brit. Jour. of Derm., Jan. and Feb., '99).

Many French clinicians regard eczema as being due to internal causes, among which digestive functions play an extremely important rôle. Series of investigations into the chemical characters of the gastric contents in such cases, with a view to finding additional evidence in support of this proposition. In almost all cases he finds disordered absorption and deficient motility. The gastric juice also shows hypo-acidity, hydrochloric acid being reduced in amount. In many instances there is dilatation, while absorption is considerably prolonged. Abnormal fermentations were a striking feature in his cases, producing excess of lactic, butyric, and acetic acids. The prevalence of such gastric disturbances the author considers should be borne in mind in all cases of eczema, in order that general treat-

ment may be employed as well as the local methods indicated for the skin. This also points to the importance of dietary, not only to reduce the tendency to abnormal fermentation, but also to obviate any arthritic complication, for, as is well known, eczematous conditions often accompany gouty symptoms. It is quite possible also that certain individual peculiarities of digestion or absorption may have to be counteracted, as there is a certain amount of evidence to show that the ingestion of certain articles of food, such as game, spiced and very salt articles of diet, etc., may be the immediate cause of an attack of eczema. Meynet (*Thèse de Lyon*, 1901; *Brit. Med. Jour.*, Jan. 11, 1902).

Immoderate habits in the use of certain foods, drinks, and drugs also indirectly or directly have an influence, such as alcoholic drinks, narcotic drugs, and excessive tea- or coffee- drinking.

Overwork, especially of a mental character, in those of hereditary eczematous tendency will often be provocative of an attack. That the hereditary disposition to the disease exists in many families cannot be denied.

Among the external exciting factors may be mentioned cold and heat, especially the former; sharp, biting winds; and too liberal use of certain soaps; the handling of dyestuffs, chemical irritants, and the like; vaccination, and exposure to certain plants. Having the hands frequently in water, as with washerwomen, the handling of sugar and flour, and repeated antiseptic cleansing of the hands often bring about the various conditions of eczema of these parts known respectively under the names of washerwomen's itch, baker's itch, and grocer's itch, and surgeon's eczema. So far as known the disease does not possess contagious properties, and in a disease so frequent as this if such existed it would have been clearly demonstrated.

In some cases of markedly inflammatory eczema, especially when of the pustular type, swelling of the neighboring lymphatic glands is noticed, but this rarely leads to suppurative change, the swelling and pain disappearing as soon as the inflammatory symptoms have abated. In some cases of eczema a condition of furunculosis is occasionally observed.

Pathological Anatomy.—Eczema is essentially a catarrhal inflammation of the skin, and is seated chiefly in the rete and papillary layer; in long-continued and severe cases the lower part of the corium and even the subcutaneous tissue may be more or less involved, but never destructively. Hyperæmia and exudation are to be found in all cases, either as punctate, localized, or more or less diffused. The vascular changes are the same as observed in all inflammations.

Diagnosis.—Eczema is to be distinguished chiefly from erysipelas, psoriasis, seborrhœa, sycosis, scabies, and ringworm.

ERYSIPELAS.—Markedly acute eczema about the face sometimes presents early in the course of the attack a resemblance to erysipelas, but in the latter disease the border is sharply defined and elevated; it usually starts from one point and spreads rapidly, and is accompanied by systemic symptoms of more or less violence.

PSORIASIS as commonly met with is not difficult to differentiate. The numerous, variously-sized, sharply-defined scaly patches, of general distribution, of psoriasis make this disease sufficiently characteristic. The face and hands are rarely involved, or only to a slight extent, at least, in psoriasis, while these regions are favorite sites for eczema. The psoriatic eruption often is seen most markedly on the extensors of the arms and legs, especially about the elbows and knees; ec-

zema is more common in the flexures. Psoriasis is usually markedly scaly, eczema rarely so. In occasional instances psoriasis is limited to the scalp, appearing here as several or numerous variously-sized scaly areas, resembling squamous eczema of this part. The same differential characters can be here recognized, if the case is studied, as when seated upon other parts. Moreover, a careful examination will usually disclose the presence of several small or moderately sized characteristic psoriatic patches on the limbs, especially about the elbows and knees. Eczema of the scaly type is usually seated upon one region, is rarely generalized in its distribution, and the area or areas are rarely sharply defined. Itching is the rule in eczema and is often absent or slight in psoriasis. In many cases of chronic scaly eczema there is often a history of gummy oozing which does not obtain in psoriasis. The eruption produced in the parasitic disease scabies and pediculosis is essentially eczematous in many of its characters, but is usually multiform, consisting of papules and pustules, the latter often being large in size. The distribution of the eruption in these parasitic diseases will often be sufficiently characteristic, and suspicion may be confirmed by the finding of the pediculus in pediculosis or by the burrow in scabies. Seborrhœa at times bears close resemblance to a mild eczema, more especially as it occurs on the scalp. The seborrhœic disease is, however, rarely inflammatory, except accidentally so; the scales are greasy, and there is lack of infiltration and thickening.

SYCOSIS.—Eczema of the bearded face may be mistaken for sycosis, but this latter disease is essentially one of the hair-follicles — folliculitis barbæ — and limited to the hairy region of the face,

and is rarely itchy. Eczema, on the other hand, is seldom limited to this region, but extends on to the non-hairy parts of the face, is not follicular, and is very itchy. Ringworm can scarcely be confounded with eczema, as eczema is seldom sharply defined, rarely ring-shaped, but is diffused, with no tendency to clear up in the centre. In cases of a doubtful character microscopical examination of the scales will be sure to differentiate.

DERMATITIS. — Dermatitis is sometimes with difficulty distinguished from eczema, as the symptoms of mild dermatitis are essentially the same as those of eczema; in fact, these cases may be looked upon as artificial eczemas. Eczema rarely, if ever, shows large vesicle- or bleb-formation as found in the severe types of dermatitis, more particularly from rhus. The history of the case will often throw light upon the diagnosis. In those eczematously inclined, however, what may be a true artificial dermatitis in the beginning may terminate in a veritable stubborn eczema.

Among other diseases that should not be confounded may be mentioned roseacea, erythema, urticaria, herpes zoster, lichen planus, lichen ruber, and impetigo contagiosa.

Prognosis.—Eczema, while often most intractable, cannot be said to be incurable. It may recur like any other disease to which a person may be prone. Under favorable circumstances mild cases yield quite readily. During the course of treatment the disease may show slight relapses, but each succeeding one is usually noted to be of a milder and less obstinate character. It is difficult, in the individual case, to state an opinion, especially as to the duration of treatment. Several factors should influence the prognosis: the extent involved, the

duration, previous variability, the nature of the exciting and predisposing causes, and whether these can be readily managed, and, finally, and of great importance, the care and attention the patient gives to the carrying out of the treatment advised.

Treatment.—There has been great diversity of views as to the methods of treatment,—*e.g.*, as to whether it should be external or constitutional. The conservative course, and that which seems to give the best results, is that which places reliance upon conjoint local and systemic measures. It is not improbable that there are some cases met with which persist without any constitutional cause, or the latter has already disappeared, and in such instances external treatment alone will bring about permanent relief. There are certain general or hygienic measures which should receive attention. The diet should be plain, but nutritious, all fancy dishes and indigestible meats and foods being avoided as much as possible.

It is very important to watch the digestive functions and the action of the kidneys in all forms of eczema. The diet is also very important, and in the majority of cases proper food is the most efficacious internal remedy. The diet should be based somewhat upon the diathesis of the patient, but it mainly consists in the prohibition of all alcoholic beverages save a small quantity of wine with a little water. Coffee and tea are diminished in quantity; fish, crabs, clams, and oysters may be given in preference to red meats. The patient is not allowed to take asparagus or cucumbers. Eggs, milk, and other light articles of diet are exceedingly useful. All fermented drinks are absolutely prohibited, and also all acid fruits. Barrazzi (*Revue de Thérap. Medico-Chir.*, June 1, '96).

Treatment includes both constitutional and local measures. The diet must always be carefully directed, and, for the purpose of furnishing best possible nerve-

nutriment, an increase in the digestible fatty matter and phosphates should be ordered. Some caution may be required in regard to the former, but with a little care the amount of fat of meats and oils, and also fresh butter, can be added to the dietary. The phosphates are found abundantly in the preparations of whole wheat, such as crushed wheat, wheat-ena, wheatlets, wheat-germs, Pettijohn's breakfast-food, etc., as also in bread made from the whole wheat-flour, some of which should be taken, if possible, three times daily. Milk, however, if properly taken, proves of the most signal advantage. It should be taken warm, pure, and alone, one hour before each meal, and also at bed-time, if sufficient time has elapsed for the stomach to be perfectly empty, which is at least four hours after a hearty meal. This precludes the possibility of adding liquor or eggs to the milk, and especially should there never be a cracker or anything else eaten with or near it. The indications for local treatment differ materially in different cases. L. Duncan Bulkley (*Jour. Amer. Med. Assoc.*, Apr. 16, '98).

Pork and salted meats, veal, pastries, strong acids or acid fruits, gravies, cheese, sauces, condiments, etc., and the excessive drinking of tea or coffee are to be eschewed. Beer, wine, and spirits are also to be avoided.

Out-door life is to be commended in suitable weather, and exercise, especially systematic in character, are of great value.

As to constitutional remedies, it may be said that there are no specifics, although arsenic seems at times of special value in chronic, sluggish, papular, and erythemato-squamous types. Each case must be carefully studied, and the predisposing factor or factors, if possible, discovered, and the treatment suitable instituted. When the itching is so intense as to prevent sleep, recourse may be had to the bromides, phenacetin, chloral, sulphonal, trional, and the like; opiates are apt to cause aggravation.

If pruritus is present an absolute milk diet must be ordered. No medicine should be given until the case has been under observation for some time, since there are few drugs which may not increase pruritus. The urine must be examined for uric acid, sugar, albumin, oxaluria, phosphaturia, and peptonuria, and the patient's organs and functions thoroughly overhauled. The most harmless cutaneous antispasmodics are asa-fœtida and musk in doses up to 30 grains, and valerian in various forms. Opium is generally contra-indicated, being itself a frequent cause of pruritus. For the insomnia, sulphonal or trional in doses up to 30 grains in twenty-four hours is much surer and generally well borne by the skin. Arsenic is useful in chronic cases, but does not suit acute cases or chronic during subacute exacerbations, with the exception of some varieties limited to the extremities or the head. In cases with a gouty diathesis, bicarbonate of sodium acts well. The dose must be moderate if given for a long time. Sulphur in small doses is very useful with young anæmic, "lymphatic," or tuberculous patients. It is contra-indicated in neurotic or cardiac cases, or when the eczema is recent and acute. It is best given as natural sulphur-waters. Besnier (*La Belgique Méd.*, May 6, '97).

In the attempt to get relief from the itching, which can seldom be obtained by local measures alone, the plan of treatment should be a soothing and protective one. Zinc ointment with 1 or 2 per cent. of carbolic acid or creasote, or with 5 to 10 per cent. of ichthyol, or tincture of camphor, is always a safe and generally beneficial dressing, but to be of service it should be kept thickly applied, spread on lint in moist places, and bound on firmly. In the acutely inflamed, and especially in the erythematous forms of the eruption, there is nothing better than the well-known calamin and zinc lotion, freely sopped on many times in the day. In the erythematous eczema of the face a tannin ointment, $\frac{1}{2}$ to 1 drachm to the 8 drachms, with 2 per cent. of carbolic acid, is effective. The use of very hot water for a brief application, followed

by an appropriate ointment, should never be forgotten. In old cases of eczema of the scrotum the effect of this treatment is sometimes very remarkable. L. Duncan Bulkley (*Jour. Amer. Med. Assoc.*, Apr. 16, '98).

In the chronic eczema of infants good results have been obtained from the internal administration of arsenic; 1 drop of a mixture of equal parts of Fowler's solution and distilled water may be given in milk after the midday meal, and gradually increased to 6 or 7 drops to infants of two years and over. In sucklings and infants under two years of age, 1 drop of Fowler's solution of the strength of 1 in 3, gradually increased to 5 drops, may be given. The treatment usually lasts sixteen or eighteen weeks. Neuberger (*Archiv f. Derm. u. Syphilis*, vol. xlvii, '99).

In chronic eczema the itching can often be allayed by the use of bran-baths, one being taken each night. The water in which bran has been boiled can be poured into a long bath, and hot water can be added until a temperature of 95° to 98° F. has been reached, or if the patient has not such a bath a washing basin filled with the bran-water can be used. Such a bath or sponging adds enormously to the comfort of patients, and by diminishing the tendency to scratch indirectly helps to a cure. R. M. Simon (*Birmingham Med. Review*, Feb., 1900).

Among the tonics that are often of value may be mentioned codliver-oil, hypophosphites, quinine, nux vomica, the vegetable bitters, iron, arsenic, and manganese. Arsenic should never be given in the acute type, or in any case in which the disease is of the spreading or active character. Among alkalies, especially useful in gouty and rheumatic cases, may be mentioned sodium salicylate, potassium bicarbonate, sodium bicarbonate, and the lithium salts.

Case of eczema of scalp in a man of rheumatic tendencies, rheumatism disappearing with appearance of eruption; cure by salicylic acid. C. E. Lockwood (*Universal Med. Jour.*, Apr., '95).

Among alteratives that occasionally are resorted to may be mentioned calomel, colchicum, arsenic, and potassium iodide. In some cases rather free action of the kidneys is desirable, and recourse may be usually had to potassium acetate, potassium citrate, and, in exceptional cases of more or less general eczema, to the oil of copaiba. Laxatives form a very important class in the treatment of this disease, as indigestion with more or less active constipation is often a striking symptom. The various salines, and aperient mineral waters, castor-oil, cascara sagrada, rhubarb, and aloes, and other vegetable cathartics are useful.

Eczema is probably an excretory inflammation; object of treatment to relieve skin by shifting the stress of elimination to sound organs; in gouty persons salines that act on the bowels and kidneys; dermatitis once started, however, becomes complicated by invasion of numerous micro-organisms; hence mild local applications, creolin ointment ($\frac{1}{2}$ drachm to 1 ounce of vaselin), or a weak creolin lotion ($\frac{1}{2}$ drachm to the pint of water) will suffice for a cure. David Walsh (Med. Press and Circ., Oct. 23, '95).

In this class of cases the several digestives and bitter tonics are often prescribed with advantage, such as pepsin, pancreatin, papoid, muriatic acid and gentian, quassia, calisaya, and other bitter tonics.

Arsenic is best given by the mouth in doses of $\frac{1}{40}$ grain of acid. arsen. Iodothyryn and thyroid-gland tabloids are extremely valuable in some of the eczematata. Oöphorin is useful in climacteric eczema. The internal treatment of acute eczema is very unsatisfactory. Locally, the best results are usually obtained by the free application of dusting-powders during the erythematous and early papular stages. These are zinc, bismuth, boro-tannate of aluminium, and dermatol. For itching, a lotion of thymol (1 in 400), acid. carbolic. (1 in 50), and menthol spirit (1

in 50 to 1 in 100), may be used under the powder, care, however, being taken not to apply it to the face or scrotum. In the papulo-vesicular stages, ordinary earth-clay, with from 1 to 2 per cent. of acetic acid, 1 per cent. of resorcin, or 1 per cent. of thymol, is one of the best applications. Lassar's paste, tumenol paste, and thiol or ichthyol paste are also valuable. When the crusts form, salicylic acid, in a vehicle of olive-oil, is useful, and an especially good formula is:—

R. Zinci oxidi, 1 part.
Bismuth. subnitrat., 1 part.
Unguent. lenient., 4 parts.
Unguent. simpl., 4 parts.

The squamous forms, with their almost absent peeling processes, are to be treated by the tar preparations. R. Ledermann (Berliner klin. Woch., Feb. 4, 1901).

External Treatment.—In the local management of eczematic cases soap and water must be used with judgment. In the acute and in many subacute cases these cleansing agents should be employed as infrequently as circumstances will permit.

Water sometimes not only delays the cure, but absolutely prevents cases from getting well. When it becomes necessary, an oily preparation containing a few drops of carbolic acid is to be used. John Edwin Hays (Pediatrics, Apr. 15, '98).

In cleansing eczematous surfaces and removing secondary products plain water or soap and water should be avoided, if possible. If the former has to be employed it should be as hot as can be borne, and the surface over which it has been used should be dried quickly and thoroughly and the selected dressing immediately applied. All detergent fluids should be warmed before use. Olive- or cotton-seed oil will cleanse almost as well as soap and water, and, if the part is carefully wiped, but little greasiness remains. Or thin strained rice-milk cleanses well and is soothing to tender and acutely-inflamed surfaces. Before any line of local treatment can

be begun all secondary products—crusts, scales, etc.—must be removed. This can be accomplished by saturating them with oil. W. M. Nelson (Mont. Med. Jour., Apr., '98).

In the treatment of periungual eczema boric-acid or salicylic-acid washes and a dusting-powder used. Resorcin may give good results in chronic inflammation. W. Dubreuilh and D. Freche (Jour. de Méd. de Bordeaux, Apr. 14, 1901).

Cleanliness may often be maintained by gently rubbing off with cold cream, petrolatum, or almond-oil. Even in such cases, however, occasional washing is necessary, both for the sake of cleanliness and in order to get rid of the products of the disease and to remove the messiness which has resulted from the applications. A remedial application should always be made immediately after washing has been employed. In some cases, especially those of a chronic and scaly and markedly-sluggish character the use of soap and water is resorted to frequently and has often a therapeutic value; indeed, in some such cases the green soap—*sapo viridis*—may be occasionally or frequently used with advantage.

Notwithstanding the nearly universal dictum of the harmfulness of water, the value of baths containing tar, or taken after the latter has been well painted over the affected regions, insisted upon. After this is effected Venetian tale is to be copiously dusted all over and around the area. Lassar (Dermatol. Zeitschr., B. 2, H. 6, '95).

A current of steam of 104° to 122° F. directed to the affected parts of the skin in eczema removes crusts and scales, occasions increased scaling of the epidermis, favors the absorption of superficial and deeper infiltrations of the skin, diminishes or even entirely stops formation of pus on the surfaces deprived of epidermis, and at the same time produces increased regeneration of tissues where, on account of chronic processes, the con-

ditions for healing are very unfavorable. A convenient apparatus consists of a thick copper cylinder containing two or three glasses, the bottom one being heated with an alcohol-lamp. On the top are two openings,—one for pouring in water (closed by means of a screw) and the other for a bent tube. According to the sensibility of the skin, the tube is kept three to five inches from it. The *séance* lasts fifteen to thirty minutes. A. Liberson (So. Russian Med. Gaz., Nos. 51, 52, '95).

Applications are to be made in eczema two or more times daily, and when possible the continuous application is to be advised.

In the selection of external remedies for a particular case common sense must be employed. In those cases in which the type of disease is acute or subacute mild remedies are to be used. In the milder erythematous variety dusting-powders of zinc oxide, talc, starch, and kaolin are soothing and beneficial; they may be used alone or immediately following the application of one of the washes named below. The conjoint use of black wash or boric-acid lotion with oxide-of-zinc ointment or any mild ointment may give beneficial results. Or the simple oxide-of-zinc ointment with 20 to 30 grains of boric acid or 3 to 5 grains of carbolic acid to the ounce may be used. A compound lotion of calamin and zinc oxide, like the following:—

℞ Calaminæ, 1 ½ drachms.
Zinci oxidi, 1 ½ drachms.
Glycerinæ, 10 minims.
Acidi carbolic, 20 grains.
Aquæ, 6 ounces.—M.

is valuable, and may be dubbed on the surface repeatedly or by means of linen or lint kept wet with it and closely applied to the diseased surfaces; or a boric-acid lotion with 1 or 2 drachms of carbolic acid to the pint, will be found beneficial, and especially applicable if the dis-

eased surface is large; or a boric-acid solution (15 grains to the ounce) may be made of the above calamin-and-zinc lotion. A so-called salicylic-acid paste, with or without 5 to 10 grains of carbolic acid to the ounce, is often of great advantage:—

℞ Acidi salicylici, 10 grains.
Amyli,
Zinci oxidi, of each, 2 drachms.
Petrolati, 4 drachms.

M. Make ointment.

In vulvar eczema only emollient preparations should be employed—bran-water, marshmallow or chamomile infusion; a little boric acid can be added to the boiled water and serve as a basis for these lesions. Following the lotion a cataplasm of cornstarch or potato-starch, made with hot boric water and applied cold, is indicated. Little compresses of tarlatan soaked in borated bran-water recommended, to be placed between the lesser lips of the vulva. The dressing ought to be renewed after each urination. During the day borated cotton should be applied to the parts.

As a curative to be applied during the intervals between acute attacks, the following is suggested:—

℞ Vaseline, 6 $\frac{1}{4}$ drachms.
Oxide of zinc,
Starch, of each, 1 $\frac{1}{4}$ drachms.
Salicylic acid, 1 $\frac{1}{4}$ drachms.—M.

The parts must have been previously bathed with borated bran-water and dried with cotton. Lutaud (Jour. de Méd. de Paris, Jan. 12, '96).

A small piece of buckskin placed between the ointment and the other part of the dressing greatly ameliorates the condition. Its good effects are ascribed to the flexibility of the buckskin, which allows it to be molded to every part of the surface; to the ease with which it can be cleansed; to the fact that it does not markedly absorb the ointment used, and that therefore the part remains moist; and to the safety with which it can be removed, the newly-formed epidermis not being torn away. Davezac (Jour. de Méd. de Bordeaux, No. 51, '97).

The following recommended to allay pruritus in eczema of the scalp:—

℞ Acidi salicyl., 6 grains.
Menthol, 12 grains.
Ol. lini,
Aq. calcis, of each, 1 ounce.

M. Sig.: For external use. Steinhart (Amer. Pract. and News, Mar. 15, '98).

An ointment of alumnol, 20 to 40 grains to the ounce of cold cream, or zinc-oxide ointment is also valuable. One containing $\frac{1}{2}$ to 1 drachm of bismuth subnitrate is also of benefit. A compound calamin ointment may be used in some cases with great advantage:—

℞ Calamin, 1 drachm.
Amyli, $\frac{1}{2}$ drachm.
Acidi salicylici, 10 grains.
Ung. zinci oxidi, q. s. ad 1 ounce.
—M.

Diachylon ointment, if a well-made one is procurable, is often serviceable. The soothing salve-mulls of zinc oxide and boric acid are extremely valuable in some cases.

In some cases of eczema in which the grade of inflammatory action is subacute, stronger applications may be resorted to, although even in this class of cases it is advisable to begin the treatment with the milder applications already named. These latter may finally, if necessary, be made stronger and more stimulating by the addition of white precipitate, red precipitate, calomel, resorcin, or tar. Of the mercurials, 5 to 30 grains to the ounce is the usual proportion called for; of resorcin, 5 to 20 grains, and of tar, $\frac{1}{2}$ to 2 drachms of the tar ointment to the ounce of mild ointment. Oil of cade may also be used $\frac{1}{2}$ to 2 drachms to the ounce of ointment. A tarry ointment such as the following may also prove useful in these cases:—

℞ Liquor carbonis detergens, $\frac{1}{2}$ to 2 drachms.

Cerat. simp., q. s. ad 1 ounce.

[Liquor carbonis detergens is made by mixing together 9 ounces of tincture of soap-bark and 4 ounces of coal-tar, allowing it to digest for eight days and then filtering. HENRY W. STELWAGON.]

If required to name one remedy only for eczema, writer would choose tar; if two, tar and lead; if three, tar, lead, and mercury. If weak enough, and used freely enough, tar solutions will almost invariably cure eczema. Common tar-water and solutions of carbolic acid are very useful; but the solution of coal-tar sold under the name of liquor carbonis detergens is the most convenient and most certain remedy. It should be used, however, in extreme dilution. A teaspoonful to a pint of water is a common strength, but often it is prescribed much weaker. It should be so weak that it does not smart, and it should then be employed like water. The parts should be bathed with it, and rags soaked in it should be laid over them, and frequently wetted from outside. Oil silk should not be used; at any rate, not in large pieces. Jonathan Hutchinson (Arch. of Surg., vol. i, p. 164, '99).

Tar preparations are contra-indicated in children, milder applications should be used. Ointments aggravate acute eczemas; a lotion of boric acid, menthol, and carbolic acid (1 per cent.) in spiritus vini Gallici is of value. In moist eczema with crusts, after removal of the latter, compresses of silver nitrate (1 in 400) are applied twice daily for two hours, and in the intervals diachylon ointment. Cases of universal eczema are treated in bed, vaselin being applied several times a day, and the inside of the night-dress dusted with starch. Rille (Wiener klin. Rund., Mar. 18 and 25, 1900).

Iodol-aristol, 5 to 20 or more grains to the ounce of ointment-base, may also be commended. In some instances preliminary paintings for several days with a saturated solution of picric acid has proved of advantage, waiting for the

films or scale thus formed to come up, and then applying a mild ointment for a few days, and then resuming the picric-acid painting.

Picric acid is indicated in those forms of eczema in which the inflammation is acute and superficial, and where the lesions are mostly epidermic. The keratoplastic action of the remedy cannot display itself in the chronic forms accompanied by induration of the skin and particularly by epidermic thickening; picric acid is incapable of modifying these chronic lichenoid eczemas. On the other hand, the keratogenic properties of the agent find an excellent field of action in acute eczemas with swelling of the integument, superficial ulceration, and weeping. Under its influence the inflammation rapidly subsides, and the acid forms (on contact with the ulcerated and oozing surfaces) a protective layer composed of coagulated proteid substances and of epithelial *débris*, under which healing takes place rapidly. Picric acid has the further advantage that it immediately stops itching; this effect is produced in chronic as well as acute forms of the disease. In acute eczema a cure is effected in from ten to fifteen days. Aubert (Thèse de Paris, No. 34, '97).

In some instances applications of dressings of a more or less fixed character are of advantage, such as the gelatin dressing, tragacanth dressing, and aca-cia dressing.

GELATIN DRESSING:—

℞ Gelatin, 15 to 25 parts.

Zinc oxide, 10 to 15 parts.

Glycerin, 15 to 25 parts.

Water, 50 parts.

To this may be added 2 parts of ichthyol.

This is heated over a water-bath each time it is to be employed, a good coating painted on with a brush, and when partly dry—in one to five minutes—the parts wrapped with a gauze bandage. The whole dressing becomes dry and

fixed, and may remain on from two to six days, and then soaked off, cleansed, and a new dressing reapplied. In some cases the larger quantity of gelatin and smaller quantity of glycerin may preferably be incorporated, and then the gelatin coating will dry more quickly and will form a sufficient dressing without the gauze bandage, although this latter seems to be of real advantage in keeping the gelatin from becoming soiled and from being rubbed off. If the gauze is not used a small quantity of a dusting-powder may be applied over the gelatin.

The above is especially applicable in the treatment of eczema of the lower legs. Other drugs may be added, but certain medicaments exercise an inhibitory influence on the setting of the gelatin, and if used should always be used with a dressing more rich in gelatin and with less glycerin and less water; such remedies are resorcin, salicylic acid, and carbolic acid. White precipitate, sulphur, and acetanilid may also be incorporated in such dressings.

TRAGACANTH DRESSING.—Pick's tragacanth dressing—linimentum exsiccans—is also a useful fixed dressing in the cooler weather. It consists of

- ℞ Tragacanth, 5 parts.
- Glycerin, 2 parts.
- Boiling water, 95 parts.

To this can be added 2 per cent. of boric acid or 2 per cent. of carbolic acid, and 5 to 10 per cent. of zinc oxide or calamin, or equal parts of both.

This is smeared in a thin coating over the diseased area and allowed to dry on, which usually requires several minutes. The parts can then be bandaged or be sprinkled with some indifferent dusting-powder. It is a more simple dressing than the gelatin application, requires no preparation, but is, upon the whole, less

useful. Other medicaments may be added in addition to those already named.

ACACIA DRESSING.—This constitutes another fixed dressing that is readily applied and which may be used on dry parts. A good formula is the following:—

- ℞ Mucilage of acacia, 5 or 6 parts.
- Glycerin, 1 part.
- Zinc oxide or calamin, or a mixture of both, 2 parts.

Carbolic acid or any other drug may also be added if desired.

This is painted on with a brush or smeared over in a thin layer with the finger; it dries in a few minutes. If at all sticky or for further prevention against this, a dry powder of zinc oxide or talcum can be applied over it.

Another method of treating these cases which can at times be employed with great benefit is by means of the so-called salve- and plaster-mulls (made by Beiersdorf). These are variously medicated. The mild salve-mulls and the moderately strong salve-mulls, and the moderate strength plaster-mulls are adapted for the subacute cases. While especially useful in some cases, occasionally their action is not so satisfactory. Their disadvantage is their costliness.

In eczema of a chronic sluggish type strong applications must be usually made before a result is brought about. The different remedies and combinations referred to in speaking of the treatment of the subacute type may be first tried; later, when necessary, treatment may assume a bolder character, various remedies being used in stronger proportion. Of value in many of these cases may be mentioned—ointments of calomel, 40 to 80 grains to the ounce; white precipitate of about the same strength; salicylic-

acid ointment, 20 to 60 grains to the ounce; resorcin, about the same proportion; sulphur, 10 to 60 grains to the ounce (used at first with caution); tar ointment, either in official strength or somewhat weakened; or the liquor carbonis detergens, with simple cerate or as a wash, pure or diluted.

Zinc-oxide paste containing 1 to 2 per cent. of yellow oxide of mercury is recommended in the squamous or the milder grades of papular or vesicular eczema of children. L. Leistikow (*Monats. f. prakt. Derm.*, Sept. 1, 1900).

Silver nitrate applied in the form of a 1-per-cent. solution favorably affects eczema in all its forms. J. C. Dunn (*Med. News*, Sept. 29, 1900).

An ointment of 20 to 40 grains of pyrogallie acid to the ounce may be cautiously tried in obstinate cases. The same may be said with regard to chrysarobin; but this latter should not be used about the face. The various fixed dressings referred to in the treatment of the subacute variety will also be of value in the chronic type. Collodion may also be used as a basis for fixed dressing in localized areas of disease. The stronger salve- and plaster- mulls and the medicated rubber plasters, the latter especially in the sclerous and verrucous forms, are also of distinct advantage in these cases; in sluggish, thickened areas repeated shampooing with green soap and hot water, rinsing off, and immediately followed by a mild ointment applied as a plaster acts admirably in some instances. Painting such areas with solutions of caustic potash, 1- to 5-per-cent. strength, allowing to act for a few minutes, then rinsing off and applying a mild ointment is a somewhat similar method of treatment which is serviceable at times. In some obstinate cases thoroughly stirring the skin with a strong remedy, instituting a substitutive inflammation, and

then applying mild remedies will not infrequently bring about the desired result.

Superficial scarification of patches of eczema employed in certain selected cases. The patches are scarified in parallel lines, one to one and a half millimetres apart, in one direction only, by a very pointed instrument penetrating to the superficial layer of the dermis. These areas are then encouraged to bleed and bathed with boiled water, and then covered with tarlatan dipped in boiled water. On reaching home cold potato-starch poultices are applied until the next treatment—generally three or four days later. Before beginning the treatment the patches are prepared by the application of continuous cold plain starch poultices. Six to sixteen treatments suffice for a cure. A reaction is set up in the patches, but no scars result. This treatment is to be used only in special cases characterized by isolated disks in limited number. Jacquet (*Bull. Gén. de Thérap.*, Jan., '98).

In infants the face or face and scalp are by far its common site. The disease may, however, occur upon any part at any age. The treatment in regional eczema is essentially the same as the treatment of eczema of any part, common sense suggesting selection or avoidance which the character of the region may suggest; as, for instance, upon hairy parts, as the scalp. Ointments containing large percentages of pulverulent substances, such as the so-called salicylic-acid paste, should not be employed, as they would tend to produce crusting, matting, and messiness.

In treating a case of infantile eczema the search for the cause should go hand in hand with the treatment, which is otherwise only palliative; carefully examine both child and mother. In an acute eczema of a few days' standing decided amelioration may be obtained by calomel. Some cases are benefited by judicious use of codliver-oil and iron. The local treatment is very important for the comfort of the patient. The crusts can be removed by salicylated oil.

Washing with water should be strictly interdicted, oil being used as a substitute. The local conditions can now be treated very happily by Lassar's paste:—

R Zinc. oxid.,
Pulv. amyli, of each, 2 drachms.
Petrolatum, $\frac{1}{2}$ ounce.

In acute cases, boric acid, 10 to 20 grains to the ounce, or in less acute cases salicylic acid, 10 grains to the ounce, may be added. Ichthyol, 5- to 10-per-cent. should be added in the older cases, where the skin is thickened and scaling is excessive. In all cases the application should be changed two or three times daily, every precaution being taken to see that the skin is kept covered and scratching prevented. Alger (Amer. Med.-Surg. Bull., Aug. 1, '96).

Favorable results obtained in the treatment of eczema by red solar light. The eruptive regions, previously covered with thin silk stuff of an intense-red color, were exposed directly to the solar light as long as possible (four hours in one case). In all the patients thus treated there was a rapid disappearance of the symptoms. W. Winternitz (Sem. Méd., Aug. 15, 1900).

There are two special forms of eczema which occur at the change of life—and the commonest, that which comes most before practitioners, is acute eczema of the head and face. There is usually considerable flushing, sweating, and other nervous phenomena, headaches, and disturbances of the digestive tract—dyspepsia and constipation. A spare woman at that time of life suddenly begins to flush in the face, perhaps after taking a meal; later the disorder becomes a little more acute; she gets an acute eczema of the scalp, and it spreads down all over her face. For that condition there is no drug or combination of drugs which is of such service to relieve the symptoms, not only the eczema, but all the symptoms mentioned, as ichthyol. It can be given in tabloids covered with keratin, which does not dissolve until it gets into the intestine. The dose should be $2\frac{1}{2}$ grains, to begin with, after each meal. At the end of two or three days it should be increased

to 5 grains, then to $7\frac{1}{2}$ grains, and then to 10 grains. If the patient tastes it much, the dose should be reduced a little.

With regard to local treatment, this form of eczema requires rather more active treatment than is needed at any other time. Such cases usually bear fairly strong applications of sulphur and resorcin.

The other form at change of life is the very acute eczema which occurs about the vulva and anus. Malcolm Morris (Lancet, May 4, 1901).

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ELATERIUM AND ELATERIN.—

Elaterium is a sediment deposited from the juice of the squirting cucumber (*Ecballium elaterium*, A. Rich). This sediment, when dried, appears in friable cakes about $\frac{1}{10}$ of an inch in thickness, flat or slightly curled, and of a pale-green, grayish-green, or grayish-yellow color, the yellow tinge appearing when the drug is old. Its odor is feeble and its taste bitter and slightly acid. It is partly soluble in hot water. It is official in the B. P., but not in the U. S. P. Elaterin (elaterinum—U. S. P., B. P.) is the active principle of elaterium, being found therein in amounts varying from 5 to 40 per cent. It is a neutral principle and appears as small, white, or yellowish-white crystals, without odor, but of a very bitter and acrid taste. It is freely soluble in chloroform, slightly soluble in ether and alcohol, and insoluble in water. Elaterin is preferred for administration because of the great variability in strength of different specimens of elaterium.

Dose and Physiological Action.—The dose of elaterium is $\frac{1}{8}$ to $\frac{1}{2}$ grain. Elaterin is given in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain, preferably in granules; a trituration of elaterin (10 per cent.) is official, the dose being $\frac{1}{2}$ to 1 grain.

Elaterium is a decided irritant to the mucous membranes and also to the skin. When given internally its chief action, in man, is to produce profuse watery stools. When given in proper doses, these large water evacuations occur without undue pain or any apparent gastro-intestinal irritation, and for these reasons elaterium claims first rank as an hydragogue purge.

Poisoning by Elaterium.—In large doses or in debilitated persons its use may produce so much prostration and exhaustion as to demand the exhibition of stimulants and other supporting measures. In addition to nausea, vomiting, excessive purging, and exhaustion, the use of too large doses of this drug may even be followed by death from gastro-enteritis. Debility from old age or other cause and gastro-intestinal irritation or inflammation contra-indicate its use. The subcutaneous use of elaterium, although capable of producing catharsis, is not advised, on account of the severe local irritation and inflammation thereby induced.

Treatment of Elaterium Poisoning.—The treatment of poisoning by this drug is practically that of gastro-enteritis. Morphine should be given hypodermically, and hot applications (stupes or flaxseed poultices) should be made over the abdomen to allay the pain and control the irritation and diarrhoea. Especial care should be had in the selection of a proper diet. Bland, easily digested, and unirritating articles of food should be selected. Predigested foods are especially useful in these cases.

Therapeutics.—In general, elaterium is indicated in conditions demanding fluid depletion; the use should not be continued if the stomach becomes disordered or the appetite impaired. It ought never be used in cases of debility

or marked exhaustion, and may be followed with advantage by alcoholic stimulants soon after its action is manifest. Its use is suggested in cerebral congestion on account of its depletant and re-constant effects. In poisoning by narcotics and in acute alcoholism elaterium is indicated when the emunctories are not acting freely.

ASCITES AND DROPSICAL EFFUSIONS.

—In these affections elaterium is a drug of great value, though one whose use demands much care and judgment. In dropsy depending on aortic, obstructive, or regurgitant disease it is especially useful, given in small doses at first, about $\frac{1}{6}$ grain, on alternate mornings at say 5 o'clock, so that its action is finished by noon. This is claimed, by Hyde Salter, to quiet the heart, relieve the dyspnoea, lessen the pulmonary congestion, and diminish the hydrothorax.

URÆMIA.—Uræmic poisoning is much benefited through the use of elaterium, as it aids the elimination of the uræmic poison by the bowel. It is especially indicated when uræmia is associated with dropsical effusion.

LIQUID EFFUSIONS OF INFLAMMATORY ORIGIN.—Under this head belong pulmonary oedema, pleurisy, and pericarditis, in all of which the hydragogue catharsis induced by elaterium may be beneficial.

ELEPHANTIASIS —Gr., ἐλέφας, an elephant.

Definition —Elephantiasis is a chronic endemic and sporadic hyperplasia of the skin and subcutaneous tissues, following an inflammatory embolus of the lymph- and blood- channels, and resulting in an inordinate enlargement.

Symptoms. —The legs are involved most frequently; the genitalia of both sexes follow closely, while many other

parts—the face, body, and extremities—are occasionally attacked.

Case of congenital elephantiasis. Mental development considerably below par. Had congenital hypertrophy of the face, eyelid, and scalp, confined to right side. The right eye had become diseased in



Congenital elephantiasis of the face and scalp. (Coley.)

early childhood, and had been removed. The hypertrophy seemed confined chiefly to the skin and subcutaneous tissue; the upper eyelid was greatly thickened and pendulous, reaching down to the upper of the alæ nasi. There was a well-marked, irregular depression in the region of the squamous portion of right temporal bone, and in one place a slight loss of bony substance. Over the posterior portion of the right parietal bone was a soft, flabby tumor of the scalp about the size of a small hen's egg, freely movable, and covered with a normal growth of hair. Coley (N. Y. Med. Jour., June 20, '91).

Three cases of elephantiasis of the upper lid, in one of which both eyes were affected. Goraud (Annales de la Polyclin. de Bordeaux, Apr., '92).

The right leg is more often attacked than the left, occasionally both are in-

volved; the scrotum is affected with greater frequency than the penis in the male, and the labia majora and minora than the clitoris in the female.

Elephantiasis of the vulva observed in a mulatto woman who was four months pregnant. The tumor encroached upon the vaginal orifice so much (the clitoris and labia majora and minora being all involved) that delivery at term would have been impossible. Hence the mass was removed with the knife, being first constricted with an elastic ligature tied under three long pins passed beneath the tumor. Bleeding vessels were thus se-



Case of elephantiasis of the scrotum. (Uthemann.)

cured separately and the wound closed by sutures. Pregnancy was not disturbed. Mundé (Amer. Jour. of Obstet., Oct., '95).

Case of a man, 19 years old, in whom the foreskin and scrotum began to enlarge at the age of 4, continuing until

it had reached the enormous size shown in illustration. Operation successfully performed. Uthemann (Deutsche med. Woch., Dec. 5, '95).

Form of chronic enlargement of the testes frequently met with in the inhabitants of warm countries, and associated, in many instances, with elephantiasis of the scrotum and lower extremities. This form of testicular enlargement, which is associated with swelling and induration of the epididymis and spermatic cord, even when existing alone, is held to be invariably of the nature of elephantiasis, and not due to any malarial influence. After castration and during an operation for hydrocele, it has been found that this condition is the result of a distension of the lymph-vessels of the tunica albuginea, epididymis, and cord, and of an excessive proliferation of the connective tissue. The filaria undoubtedly plays a considerable part in the genesis of such morbid conditions. Le Dentu (Revue de Chir., Jan., '98).

No inconvenience or pain accompanies the disease in the majority of cases, but very often when the scrotum is the part attacked stomachic and nervous distress is encountered. Radiating pains may be observed in the seminal nerves, thus causing intense nausea and vomiting. Hydrocele may be induced.

The prodromic stages differ according to whether the elephantiasis occurs in hot or cold climates. In hot countries there appears a preliminary fever termed "elephantoid fever," which is preceded by pains of great intensity in the lumbar region, accompanied with retching and vomiting, cold shiverings located along the spine, followed by fever and profuse perspiration in successive alternations. The colder atmospheres do not occasion such marked distress during this early stage.

In patients suffering from elephantiasis once or twice a month there is an excess of fever. The local symptoms accompanying the fever are those of lymphangitis with ganglionic enlargement.

These attacks of lymphangitis with fever coincide with the invasion of the connective tissue of the hypoderm and of the associated lymph-channels by microbes. The visible lesions are the result of hundreds of febrile crises, each accompanied by a fresh advance of œdema. Each new œdematous deposit is probably followed by local organization of the emigrated embryonal cells in adult connective tissue. Tropical elephantiasis is usually due to the *Filaria sanguinis hominis*. Sabouraud (Annales de Derm. et de Syphil., May, '92).

The course of the affection, whether occupying the leg or elsewhere, is characterized by frequent exacerbations. Deeply-seated, recurrent forms of dermatitis, or attacks of an erysipeliform (or true erysipelas, the streptococcus of erysipelas being found in some cases) inflammation, with, at times, involvement of the lymphatics (from which milky or chylous discharges may be noted with or without puncture) are encountered. While these phenomena are primarily localized in the deeper tissues, the skin does not seem to be attacked until later, when it presents nodular increase in size.

With proper measures these symptoms abate, only to reappear at some later period. At each successive attack the part is noted to have increased in size to an appreciable extent. These recurrences of fever and œdema may appear at intervals of weeks only, while months or years may intervene between each recrudescence. At times the recurrences of these phenomena may be so frequent or so close that the previous inflammation has not had time to disappear. As each attack leaves an increase in size we may, after a time, find a gigantic enlargement of the part involved. These inflammatory phenomena may not always be observed, as the part may often be found to increase in size without their apparent assistance. It is difficult to cause pitting

in these structures, owing to the general hyperplasia. The skin, as previously noted, does not appear to participate in this process early, but later it becomes likewise affected. It is tightly stretched, glossy or waxy, with pigmentary changes of color varying from brownish red or pinkish red to one of dusky brown. Upon its surface may be seen an accumulation of sebaceous material, with here and there desquamations of epithelium. The linear fissures of the skin may increase so greatly that enormous sulci may be formed. Hard or soft tubercles may appear upon its surface at various parts, either showing some scaly desquamation at their summit or becoming denuded of epithelium; they present numerous bleeding-points or the top of the tubercles may be one bleeding surface. In fact, many cases seem to present a chronic eczema upon the skin of the thickened part, and this appears to follow its usual characters. In other cases shallow ulcers, which resemble ordinary breaks of continuity, may be found at points over the affected skin. The parts around the joints form decided strictures, and the overlapping enlargement thus causes deep fissures in which a milky or chylous exudation, intermixed with sebaceous discharge, cause painful maceration of the inclosed skin. At certain points the lymphorrhagia may be so excessive as to cause great depression of vitality.

While this increase occurs in the softer parts of the affected structures, the bones alike share the enlargement in all their dimensions, and glandular involvement is often noted. The leg resembles closely its counterpart in the elephant both externally and in size-proportion. The weight becomes out of all proportion to other parts of the body, and while subjective sensations are, for the most part,

encountered during the inflammatory attacks, they may be observed after the affected portion has been allowed to remain in one position for an indefinite period. Pain is then found to follow excessive fatigue, and tearing, stabbing sensations are reverberated throughout the affected leg. When other parts—such as the scrotum and penis or the labia and clitoris—are involved, the same process intervenes and the enlargement hangs down between the legs, and may weigh many pounds. The penis usually becomes indistinguishable in the large mass and an opening or groove is left through which the urine trickles. The face (cheeks and nose), shoulders, arms, forearms, and the hands may share in the tumefaction, but do not show the same complications observed when the leg or genitals are involved. Other enlargements of enormous extent are described, such as the elephantiasis telangiectodes of Virchow, which is of congenital origin and affects the vascular tissues.

Case of elephantiasis telangiectodes and molluscum fibrosum in a small, rather deficient man who showed a number of sessile tumors, more or less subcutaneously movable, over the body and limbs. Patient's mother and father had also suffered from small subcutaneous tumors. There was inequality of the lower extremities, and marked irregular hypertrophy of the left femur, and on the left tibia was a large osteal growth. Large, loose folds of elephantiasic growth existed on the left thigh. The case illustrated the hereditary character of the affection; its occurring in one somewhat imperfectly developed in mind and body indicates the connection between elephantiasis and molluscum fibrosum and a condition analogous to the fibrovascular hypertrophy of the subcutaneous connective tissue taking place in the osteal tissue. Calwell (Brit. Med. Jour., Jan. 4, '90).

Diagnosis.—Cases of elephantiasis after reaching their full development are

easily recognizable. The enlargement, with difficulty to cause pitting; the appearance of warty or keloid-like tumors; the history of repeated attacks of erysipelas, deep dermatitis, or a recurrent eczema, should be sufficient to draw attention to this affection.

Care should be taken not to confound elephantiasis with pendulent tumors, such as overhanging forms of fibroma, which may closely resemble the enlargement found in the former affection. Enlargements due to eczema or syphilis will usually present symptoms of both of these conditions sufficient to prevent error if care be taken. Acromegaly and myxœdema present symptoms which will be sufficient, if carefully studied, to make a proper diagnosis of these conditions. Constriction of a limb by means of bandages happens very frequently, and, as enlargement may follow, close examination will reveal the reason for this increase. In fact, close attention to every detail should be carefully studied, when the diagnostic differences of the several similar affections may easily be detected.

Etiology.—While the affection may be observed in any country, certain regions, owing to their climate, are noted for the prevalence of an endemic type of elephantiasis, while sporadic types prevail in other countries. It attacks both sexes, although the male, however, three times more frequently than the female. Age does not seem to influence its appearance, but middle or adult life shows the largest number of cases. Congenital types may be noted.

The influence of heredity has been shown by many recorded cases. Change of climate seems to lessen the tendency of the disease, and cases are benefited in which the affection has proceeded for some time. Unhygienic surroundings—such as malarious districts or parts bor-

dering upon the sea—exert a deleterious influence. The fair types of mankind do not show as marked a tendency to the affection as do the darker types.

The mosquito is thought to play an important part in the production of elephantiasis. Encroachments of large tumors, as well as pressure of various kinds, upon the veins and lymphatics are also considered as predominating etiological factors.

Case in which, two years before, the patient had acquired syphilis and suffered from suppurative buboes in both groins, the left side being the worse; she treated the affection herself. A year later she first noticed an increase in the labium majus of the left side, and this has steadily gone on until it is the size of the fist. In both groins there are scars, that on the left being deeper and more extensive. This case regarded as having an important bearing on the treatment of bubo. The extensive destruction of the inguinal lymphatic vessels was the result of neglect of early incision and antiseptic treatment of the suppurative buboes. The elephantiasis described is due to the obliteration of the lymphatics. M. Schreider (*Derm. Zeit.*, B. 2, H. 5, '95).

Case of elephantiasis observed in a little girl 3 years old. Her grandmother had had several attacks of lymphangitis of the legs, followed by elephantiasis. The mother of the child never had either of these diseases or erysipelas. A fall upon the abdomen is thought to have an etiological relationship to the disease of the child. When the baby was born a deformity of the face was found which was due to an abnormal production of a soft, elastic, uniform, and indolent tissue, which spread from the zygoma to the external commissure of the eyelids and back to the insertion of the ear posteriorly from the mastoid process to the inferior border of the thyroid cartilage. A number of these cases observed, and the explanation advanced is that, streptococci having found their way into the fetal circulation through the placenta, an inflammatory process was set

up in the foetal tissues, resulting in the overgrowth of tissue. Moncorvo (Pediatrics, Dec. 1, '97).

Two cases, one certainly preceded by syphilis and the other accompanied with symptoms which were in all probability tertiary; in both excellent results were obtained by iodide of potassium, in one after amputation of the enlarged left labium. In the great majority of instances chronic ulcerative processes of the vulva with elephantine thickening are of syphilitic origin. Bamberg (Archiv f. Gynäk., Bd. lxxii, H. 3).



Unilateral elephantiasis of the face and neck. (Moncorvo.)

Pathology.—The changes of elephantiasic areas are more directly located in the subcutaneous tissues, the upper and lower strata alike sharing in the characteristic phenomena. The skin, although presenting these changes, is more markedly affected where papillary outshoots are observed. Upon cutting into the affected areas there is observed a yellowish or grayish mass, which in some places shows a resemblance to fatty or larda-

ceous deposits, while in others gelatinous formations are simulated. Exuding lymph may be observed at many points. The changes from the normal are of a distinct hypertrophy: there is decided proliferation of the epidermis, with hyperplastic increase of the corium, while the fibrous elements of the subcutaneous tissue are observed in hardened bands or meshes or noted to be soft or liquefied. Distended lymph-spaces are found throughout the microscopical section. All the soft parts, the blood-vessels, lymphatics, nerves, and their component parts, as well as the bony structures, share in the general enlargement and cell-infiltration. At times, the muscles and the glandular structures of the skin participate in the increase of size.

Obstruction is clearly the influence in the production of elephantiasis. The presence of the *Filaria sanguinis hominis* in the lymph-vessels is directly the cause in endemic varieties of this condition. Manson states that the parent-worm occupies some portion of the lymph-trunk, at which point it discharges the ova into the stream of lymph; these are then carried forward to some of the glandular structures, in which they find a lodgment. When hatched they enter the general circulation. Abstracted from the blood by the mosquito, and deposited again into a water-stream, the ova again reach man when contaminated water is employed. The more aggravated the symptoms, the more numerous are the parasites in the lymph-channels. Hæmorrhage and discharge of lymph may be observed in these types.

In sporadic types of the affection, in which the obstruction may be induced through encroachment of large tumors or other forms of pressure upon the veins and lymphatics, the same features are

developed. Although they are indistinguishable, there is no mistaking the condition. Eczema of a most chronic variety, frequent attacks of erysipelas or other forms of deep dermatitis, as well as tight bandaging of a part may also be the inducing factors.

Prognosis.—Although the disease does not tend to shorten life, much discomfort, as well as intercurrent maladies, may place the affected person in an unenviable condition. Endemic cases may be greatly benefited by a change from a malarious or sea district. Sporadic types are likewise improved by change of climate. The discomfort may alone be caused by the weight of the affected part, which may often be removed by surgical measures, thus insuring relief. Early cases should be immediately removed to other regions; if this is done, a favorable result will be reached early. This step often arrests even cases of long-standing.

Treatment.—In endemic cases which are preceded by the preliminary fever, with its accompanying phenomena, recourse must be had to the measures generally adapted to most febrile manifestations. Salines, acetanilid, quinine, and cinchona, which influence miasmatic fevers and their consequent complications, should be administered. Tonics will be demanded in many cases in which the depressing effects of recurrent attacks of erysipelas or deep inflammations are experienced. Codliver-oil, with or without the hypophosphites, iron, strychnine, certain mineral acids (hydrochloric or sulphuric), and possibly arsenic may be found beneficial. Again, all complications should be remedied as they appear in the several cases encountered. All cases of this affection should be removed from countries in which the disease is endemic or where malarial or other miasmatic atmospheres are found. Spo-

radic cases are to be removed as well to some healthy climate. Iodine (or its preparations) and mercury have been recommended for their absorbent qualities. Sterilization of drinking-water at all times may have an indirect influence in the prevention of this disease.

Surgical interference, of one kind or another, may be productive of some fairly-good results. Large growths of enormous weight have been removed by this means. The penis and testicles have been restored to their normal conditions in a large number of cases.

Series of sixty operations successfully performed. The weight of the tumors varied from one and a half to thirty-nine pounds. The usual incision is made along the penis, which is thoroughly decorticated; and by vertical incisions over the cords, down to the fundus of the tumor, the testicles are enucleated, and, all blubbery material being carefully removed, the organs are placed on the pubes in a wrapping of gauze. The upper ends of the vertical incisions are joined to the wound over the penis. Lateral oblique incisions are made through healthy skin and fat along the sides of the tumor; they pass downward, so as to meet just in front of the anus. The mass is then carefully dissected off, exposing, on its removal, the accelerator urinæ in the middle and the limbs of the pubic arch at the sides. All bleeding vessels are ligatured. One now sees the decorticated, but turgid, penis; the testes with cords of, it may be, eighteen inches' length; and a large triangular wound, fairly representing the superficial dissection of the anterior half of the perineum. The skin and fat bounding the wound on either side are raised up from the fascia lata, over the hamstrings, for a distance of about three inches. The testes are united to each other in the middle line by three or four interrupted sutures. The edges of the sliding lateral flaps are then brought together over the testes by a series of strong quilt-sutures. The penis is covered by the anterior end of the

thigh-flaps, and by flaps raised from above the pubes, with or without the addition of Thiersch grafts. The whole wound-area is dusted with iodoform, and covered with suitable dressings. It is essential that the dressings be kept in place by well-applied bandages. Healing takes place throughout by first intention in about eight days. Havelock Charles (Indian Med. Record, No. 5, '97).

The cicatricial tissue following this treatment always gives a protective covering to the structures. Surgeons have abandoned the use of the ligature because of the likelihood of causing more disturbances to the already-obstructed circulation. The method of treatment generally resorted to by surgeons at the present day is compression. This may be considered as equal in value to ligature, but it is less likely to provoke other conditions likely to promote enlargement. Pressure may be applied by the use of some form of bandaging. Elastic bandages, such as those advocated by Martin, or ordinary muslin of close texture, to insure firmness, may be applied to the enlarged areas, beginning at its lower and approaching the upper part in gradual pressure. This means has been followed, however, by untoward consequences, such as gangrene at one point or another, and should be carefully watched.

Marked success from hypodermic injections of calomel in a case of elephantiasis in a woman 39 years old. Although the patient developed symptoms of syphilis, yet the latter occurred after the appearance of elephantiasis. The author concludes that intermuscular injections of calomel have a beneficial effect on elephantiasis, but they must be continued for a considerable time, with frequent interruptions. Tiptseff (Meditzinskoje Obozrenije, vol. lvii, No. 9, 1902).

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Philadelphia.

EMPHYSEMA. See PULMONARY EMPHYSEMA and INDEX.

EMPYEMA, THORACIC.—Empyema: Gr., *ἐμπνεῖν*, to suppurate.

Definition.—Empyema is an accumulation of pus in the pleural cavity independent of the lung-tissue.

Varieties.—The various kinds of suppurating pleurisies are pulsating empyema, multilocular empyema, tuberculous empyema, double empyema, putrid empyema, and interlobular pleurisy.

When a collection of pus is so situated as to be synchronous with the heart-beat, it is denominated pulsating.

In cases of pleuritic adhesions and the circumscribed diaphragmatic pleurisy, we often have encysted collections, which are usually many in number. Tuberculous empyema occurs in scrofulous subjects and is often localized, with caseous masses. Double empyema occurs simultaneously on both sides, while interlobar pleurisy is the inflammation in the visceral pleura, or that covering the lung, and pyæmic exudation accumulating in the interlobar fissures.

The interlobar empyemas are not primarily abscesses of the lungs, but of the pulmonary pleura; but necessarily assume the form of abscesses of the lung if not circumscribed by adhesions or evacuated early. The putrid empyema is a form resulting from neglect and long exposure to the various pyogenic microorganisms, such as saprophytes, and the streptococci and staphylococci, resulting in pyæmia and septicæmia.

Symptoms.—In most cases of empyema there is a history of exposure to dampness or overheating. A chill comes on, then fever, and pain in the side. The disease may not have been regarded as serious or a relapse may have occurred. In a few days dyspnœa and unusual

restlessness call the attention of the patient again to his chest. In a month or two the clinical picture has gradually changed; the patient, perhaps florid and plethoric, may have become emaciated and morose, a short loose cough suggesting the presence of consumption, which apparently becomes confirmed when night-sweats are noticed. The aspect of the face and the posture is that of extreme exhaustion. The physical signs are pain in the side affected. This may be one of the first symptoms; but the most marked of these is discomfort due to dyspnœa and to the absorption of pus.

The skin may be clammy and bathed in a cold perspiration. The respiration is about 40 to the minute; temperature from 103° to 105°. There is dullness on the affected side, with change of sound under auscultation and percussion when sitting, when lying down on the back, or if the patient be turned on one side.

Twenty patients examined with special care in regard to the change of level of a pleuritic exudation as the patient's position is altered. Anything that might, by acting as a damper upon the thorax-wall, give rise to apparent dullness, such as pillows, mattress, supporting hands placed against the back, etc., was avoided, many of the apparent changes in the level of dullness being due to these agents. The thorax-wall must be set in vibration and give character to the percussion-sounds. If a damper is so applied as to stop these vibrations, a dull note results. A normal thorax, if percussed in the position a pleuritic patient assumes, will give a dull note on certain lines. In only one case out of the twenty did the examination reveal any change in the line of dullness. Strauch (Virchow's Archiv, June 1, '89).

By far the most important aid in diagnosing that empyema has followed pneumonia is the temperature. The usual thing, if empyema follow, is for the temperature to fall when the crisis takes place, for it to remain down two or three

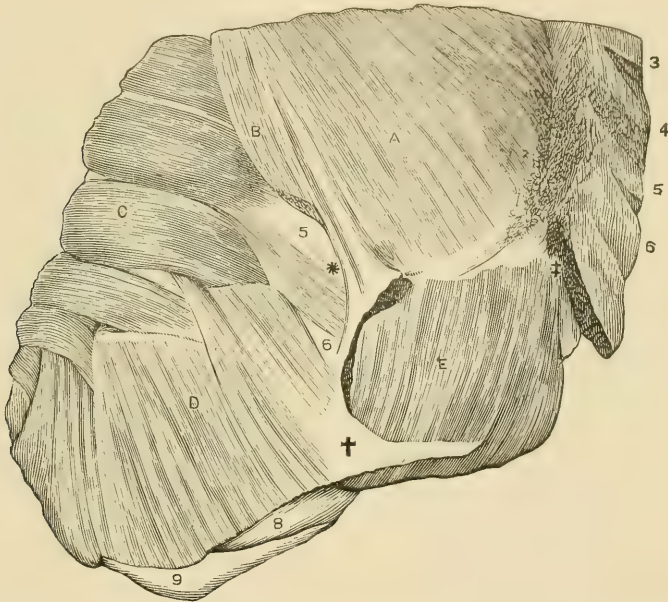
days, for it then to rise again, so that it soon becomes from 2 to 4 or 5 degrees above normal in the evening and about 1 or 2 degrees in the morning; this continues until the pus is evacuated. Sometimes the apyrexial interval is only one day, sometimes it is four or five days, and sometimes there is not strictly an apyrexial interval, for the temperature does not fall at the crisis to normal, but only to nearly normal, and then soon begins to rise again, so that instead of an apyrexial interval we have an interval of lower temperature. There is a fall of temperature at the pneumonic crisis with a subsequent rise in about a third of all the cases in which empyema followed pneumonia.

In many cases there is no apyrexial interval, and probably in some of these pus is present from quite early in the illness. W. Hale White (Lancet, Nov. 10, 1900).

Empyema in children usually follows lobar pneumonia, after a varying interval. The infection is usually with the pneumococcus. Spontaneous cure, even when aided by tapping, is rare. Operation should not be delayed, as time lost is strength lost, and the issue is largely one of nutrition. The best form of operation is in general the subperiosteal resection of an inch of the eighth or ninth rib in the posterior axillary line, the evacuation of pus and fibrin masses, and tube-drainage. Irrigation at or after operation is not usually advisable. Routine after-treatment in fresh cases should be tube-drainage, the tube being progressively shortened, and removed when the cavity is nearly healed. Where failure to heal seems to depend on failure of the lung to re-expand, treatment by valve or suction apparatus is indicated. This is especially of value in the more chronic cases. The mortality is about one in seven; in small children it is much greater than in those over five years. The causes of mortality are, in the main, beyond our control. The great majority of cases heal even when the healing is delayed for many months. Chronic empyema, in the strict sense, is rare in children. The closure of the cavity depends mainly on nutrition and

on adequate drainage. Recurrence may take place from faulty drainage at any time, and it may occur years after apparently sound healing, without obvious cause. Deformity of the chest is usually temporary, and yields to treatment. Long-continued discharge from the cavity is not infrequently followed by chest deformity and scoliosis of a severer type, permanent, and sometimes extremely severe. Cotter (*Boston Med. and Surg. Jour.*, July 17, 1902).

fremitus on the affected side. If a finger-tip of the left hand is held in an intercostal space over the region and a finger-tip of the right hand is held in a corresponding intercostal space on the sound side, and the patient is told to count audibly, no sound-waves seem to be transmitted to the finger placed in the intercostal space on the affected side, and the finger on the sound side feels the im-



Lower part of thoracic walls on the right side. *A*, pectoralis major; *B*, pectoralis minor; *C*, serratus magnus; *D*, external oblique; *E*, rectus abdominis; 3, third costal cartilage; 4, fourth costal cartilage; 5, fifth costal cartilage; 6, sixth costal cartilage; 7, seventh costal cartilage; 8, eighth costal cartilage; 9, ninth costal cartilage; *, placed just above Mr. Marshall's spot; †, aponeurosis, common to external oblique and pectoralis major and covering rectus; ‡, xiphoid appendix.

Skodaic resonance is a term used to indicate Skoda's discovery of an area near the clavicle which is always free from the extreme flatness found in empyema,—unless this area be also invaded in cases where the dullness is found in all portions of the chest, in which case the cavity is full of pus. This is also accompanied by a disappearance of the vocal

tract or vibratory motion communicated through air by the sound-motion. The symptoms of serous effusion vary slightly, and yet this wave-motion may be communicated better by serum than by pus.

The variety of sounds heard in the early stages of pneumonia upon auscultation is followed by a complete loss of sound on the affected side in empyema.

The respiratory murmur is *nil*. The bronchial murmur above may be perceptible.

The most-marked cases are the only ones in which all of these signs and symptoms obtain; for, with a small accumulation of pus, very little more than the rise of temperature and dyspnoea exists. The final termination of a case not recognized and treated would be a pointing and rupture externally or internally. The most usual points of rupture have been the weakest and least resistant: *i.e.*, internally, above into the bronchi or trachea; and, externally, at the free spots of Marshall or of Traube. The point on the right side which is comparatively free from muscular covering is called the free spot of Marshall, while that on the left side, as in this case, is called the region of Traube. (See wood-cut.)

[The spontaneous discharge of empyema without any untoward results was observed by me in the case of a young girl, aged 8 years, who had been attacked with influenza, and, later, with severe pleurisy, accompanied by high temperature, weak and rapid pulse, night-sweats, and hectic, showing great absorption of pus. In the course of time, a prominence about the size of a hen's egg was noticed on the right side near the costal cartilage. After a simple incision the pus was fully evacuated through the opening, which remained patulous for about three years. The examination of the patient now shows a slight lateral curvature of the spine, with a lack of development of the mammary gland on the right side, but with a considerable chest expansion and very slight impairment of the lung. The patient is rapidly developing into womanhood and has regained her health and strength.

The discharge of pus in the left side was observed by me in a boy at Anniston, Ala., in whom a serous pleural effusion had been aspirated, and had been treated by medication also. The degen-

eration of serous exudation into pus was verified in this case. Osler has stated that he has never seen a case of sero-fibrinous effusion degenerate into purulent pleurisy, but, according to W. M. Pirt, literature shows many similar cases. The region at which the pointing occurred in this case was in the left intercostal space, immediately below the apex of the heart. I performed the operation of resection of a portion of the sixth costal cartilage on the left side, and secured drainage with a strip of gauze passed daily through the fistulous tract. The patient made a good recovery, also; and, being young and vigorous, overcame the tendency to scoliosis. The last report from him showed that there had been no redevelopment of pus, and that the fistula had been closed. J. McFADDEN GASTON.]

The Marshall and Traube regions are points of least resistance and, although higher than the pus sometimes reaches, may be considered the most available for spontaneous discharge. It is for this reason, and because the region of Traube is least liable to complications with the diaphragm, pleura, and abdominal wall, that Jaccoud, of Paris, selected it for the introduction of a trocar. J. H. Cox has reported a case in which spontaneous evacuation took place in front between the sixth and seventh ribs. Recovery followed.

The pus may discharge through the intercostal spaces, but fail to reach the surface at the point on account of muscles; then it burrows beneath them. In regard to the spontaneous escape of pus in thoracic empyema, a case has been reported in which it took place at the umbilicus. This location of the weak point is a corroboration of the theory that pus escapes at the point of least resistance, and not always at the point of the lowest pressure. (J. G. Willis.)

[I witnessed the case of a man at the Atlanta Polyclinic, who had a whole

quart evacuated from the incision made into an axillary abscess communicating with an empyema. The patient was lost sight of after the first evacuation by me, and it is supposed that he must have been relieved by the use of a gauze drainage and packing at that time. J. McFADDEN GASTON, JR.]

Diagnosis.—The diagnosis may be made from the extreme dullness and lack of respiratory sounds, when the temperature remains elevated. But an exploratory puncture is advisable to determine definitely a case of empyema.

Subphrenic pyothorax can be recognized by the results of high and low aspiration, in a large percentage of all cases. High punctures, in the fifth intercostal space, show a collection of pus or serum, while low punctures, as the eighth intercostal space, yield pus which is always ichorous. Scheuren (Charité-Annalen, vol. xiv, p. 158, '89).

Two cases of pulmonary abscess simulating empyema. Kauffmann (Birmingham Med. Review, Oct., '93).

Case of subdiaphragmatic abscess containing pure culture of bacillus coli communis observed which simulated empyema. F. Tilden Brown (N. Y. Med. Jour., Feb. 29, '96).

In the New York Foundling Hospital during the last ten years there were 82 cases of empyema, and 69 of these were under two years of age. In 28 cases there was no involvement of the lung. Clinically, it is at times most difficult to diagnose and locate the pus. In opposition to the course of empyema in adults, in children the disease is short and critical, some cases dying within forty-eight hours, and the mortality, in all cases of children, is very high. The rational signs are the same as those of pneumonia, and the only positive sign is the finding of pus with a large exploring-needle. Practically all pleural effusions in infancy are either purulent from the beginning or soon become so, and when pus has been found drainage is called for. D. Bovaird (Med. News, Dec. 23, '99).

Pleuritic effusion and a carnified or hepatized lung should be borne in mind, and they may be excluded when the exploring needle reveals pus.

At times cases of empyema may be confounded with ordinary intramural abscesses, as when they occur near the axilla, and are incised. We have found several cases among negroes treated late and who had been neglected.

Etiology.—Pleurisy with its usual sequelæ of pleural effusion is the most common etiological factor. The inflammatory complications of pneumonia are also among the causes.

There are four main groups of cases of empyema in children. The first is the metapneumonic, the diplococcus pneumoniae playing chief rôle as etiological factor. In the second group the only micro-organism found in the pleuritic exudates is the staphylococcus pyogenes or a streptococcus. The third group is due to the tubercle bacillus, and the fourth is the so-called putrid or foetid empyema. Henry Koplik (Med. Record, Jan. 25, '96).

It is impossible to state with accuracy the percentage of cases in which pneumonia is followed by empyema, but it is interesting to note that out of 325 consecutive cases of empyema in the medical wards of Guy's Hospital, there were 41, or 12.6 per cent., in which it appeared that the empyema followed a lobar pneumonia. W. Hale White (Lancet, Nov. 10, 1900).

Clinical study of one hundred and thirty-five cases. When the streptococcus is present and is due to suppurative or pyæmic conditions outside the chest, it is usually of a virulent type and has a correspondingly bad prognosis. In the metapneumonic cases the prognosis of streptococcus is little worse than that of lanceolatus. The particular organism present is a less cogent factor in determining the need of operation than the fever, prostration, chills, the quantity of pus-cells present, and the tendency to refill after operation. The grad-

ual development of pus after successive aspirations can usually be predicted from the presence of streptococci or pneumococci in the first fluid withdrawn, even though that be a clear serum. But pus may also appear when the earlier tapplings are sterile. C. F. Withington (Boston Med. and Surg. Jour., Nov. 6, 1902).

Trauma may also give rise to the effusion.

Tubercular empyema may follow the perforation into the pleural cavity of a tubercular peripleuritic abscess, originating in a tubercular osteitis of the ribs or vertebræ.

Tuberculosis is thought to be caused by pleurisy; on the other hand, Germain Sée and others are quoted by J. C. Castillo, of Lima, Peru, as regarding three-fourths of all pleurisies tuberculous in their origin.

The most frequent cause of pleurisy is, as has been said, the bacillus of Koch.

Children are especially liable to empyema following pneumonia; pneumonia caused empyema in 50 per cent. of personal cases; all were of severe type. A tuberculous family history exerts little influence on empyema. In about one-sixth of the cases the empyema was sacculated; the pneumococcus was found in 50 per cent. of the cases in which examination was made; the streptococcus in 22½ per cent.; the staphylococcus in 8 per cent.; the tubercle bacillus in 4 per cent.; and no bacterium in 16 per cent. The pneumococcus produced the most virulent infection. J. A. Hartwell (Med. News, July 13, 1901).

Pathology.—When the inflammatory process sets in, the pleura becomes thickened, and this, besides the inhibition of the lubricating secretions that occurs, gives rise to a friction-sound: one of the first symptoms of pleurisy to present itself, as well as one of the last to disappear.

The lubricating fluid is rather increased as an effort on the part of nature

to repair the damage done to the surfaces by their congested, uneven thickening. This fluid becomes gradually so plentiful that at times it is sufficient to form serous effusion. If the inflammatory product should continue or if pyogenic microbes invade the cavity, suppuration results, and we have empyema.

Case of calcareous empyema followed by death. Post-mortem the lung was collapsed and the pleura thickened and coated on its whole internal surface by a thick crust of calcareous deposit, including the upper surface of the diaphragm. The sour, milk-like odor of the discharge toward the last suggested that lactic-acid fermentation was taking place within the cavity. T. Carwardine (Bristol Medico-Chir. Jour., Mar., '98).

Prognosis.—Cases seen early result favorably under proper treatment; hence the rule that cases of empyema should never be allowed to grow old.

Six hundred and fifty-six cases of empyema in children, with one hundred and four deaths. The younger the patient, the greater the risk of fatal termination. The sooner the purulent effusion removed, the quicker the recovery. Danger to life is chiefly due to complications: pericarditis, peritonitis, septicæmia. Wightman (Lancet, Nov. 30, '95).

Considerable practical prognostic importance attaches to the bacteriological study of the pus of empyema. Thus, empyema in childhood, caused by the pneumococcus, is quite benign and runs a rapid course to recovery, while that caused by the streptococcus runs a slower course and is more serious. Tuberculous pleuritis is a chronic process usually terminating fatally, or lasting for years until tuberculosis or an intercurrent affection carries off the patient, or he gradually succumbs to prolonged hectic amyloid disease and asthenia. Errors in diagnosis may be caused by the tendency to sedimentation of the pus, when an exploring-needle may withdraw clear fluid from the upper layer instead of pus.

Joseph McFarland (Phila. Med. Jour., Sept. 8, 1900).

Very much depends upon the nature of the infection. The readiness with which the compressed or retracted lung returns to fill the cavity marks the difference between a case of favorable and rapid progress to complete healing and a protracted one, ending possibly in extensive rib resection with deformity. As to the bacteriology, the two main features are the comparative frequency of staphylococci and the rarity of the diplococcus pneumoniae. Some doubt must remain as to the exact relationship which the bacteria bear to the production of pus. W. F. Hamilton (Montreal Med. Jour., Oct., 1900).

In all cases the most serious consequence of the affection is deformity, and in children lateral spinal curvature is likely to occur. Pyæmia and septicæmia will result from putrid empyema; and general miliary tuberculosis may follow a localized tuberculous pleurisy which becomes purulent. Rupture into the bronchi, trachea, lungs, with immediate death from suffocation, or into the stomach after perforating the diaphragm, are among the possibilities.

Treatment.—The satisfactory results obtained by Murchison in the treatment of pleural effusions by incision would seem to point to the surgical treatment of many cases, before empyema has set in, as a valuable measure. For this purpose also the use of blood-letting, blisters, and medication may be employed to abort the inflammatory process sufficiently early in the progress of pleurisy that an empyema need not follow. Blisters and purgation with salines and mercurials should be actively employed, in order that the parts undergoing inflammatory changes may be relieved of the fibrinous element of the blood, tending to retard resolution. Opiates, and especially the camphorated tincture of opium, may be used to relieve pain and

hasten the resolution. Carbonate of ammonia, turpentine, and digitalis are all also of value.

[I would strongly urge, especially in children, of an early recourse to the following preparation:—

R Hydrargyri chloridi mitis, 1 grain.
Pulv. ipecac. et opii, 10 grains.
Quininæ sulphatis, 10 grains.
Pulv. camphoræ, 1 grain.

M. Divide into powders No. x.
Sig.: One powder every two hours.

In adults:—

R Hydrargyri chloridi mitis, 6 grains.
Pulv. ipecac. et opii, 30 grains.
Quininæ sulphatis, 30 grains.
Pulv. camphoræ, 6 grains.

M. Divide into capsules No. xij.

Sig.: Take one every two hours in day-time, and two capsules at intervals while awake at night.

This should be followed with two tablespoonfuls of oil and one teaspoonful of turpentine.

The bowels are thus emptied, and the turpentine has a beneficial effect upon the bronchial tubes.

I have seen many cases of incipient pleurisy aborted in this way, and the most alarming symptoms of high temperature and rapid respiration controlled. J. MCFADDEN GASTON, JR.]

The full and free evacuation of the pleural cavity is not expedient when the pressure has been great, and the lung is pressed upon in such a manner as to displace the heart. In such a case the gradual evacuation by aspiration is preferable.

Aspiration should be limited to one or two trials, for empyemas of the metapneumonic type, as seen in children and adolescents. For all other cases free incision and drainage are indicated. Ransohoff (Ohio Med. Jour., Aug., '93).

Cases in which pus contains large masses of lymph, or pus, thick and creamy, heal best. Offensiveness of pus does not much influence healing. Delay is advisable when there is negative pressure in the pleura, and when expansibility

of the lung and contact of layers of pleura can be induced by simple aspiration and cure effected. Otherwise harm will result from delay. Resecting a piece of rib, free incision of pleura, and continuous drainage indicated. Pollard (*Brit. Med. Jour.*, Nov. 2, '95).

In children chloroform is the preferable anæsthetic, but deep narcosis is contra-indicated, owing to the danger of pus being drawn into the other lung from a ruptured bronchus. In adults with general empyema two inches of the seventh and eighth or eight and ninth ribs in the posterior axillary line should be resected. In children the same length of the seventh rib. Simple incision, with our present knowledge, is rarely advisable. The operation is indicated as soon as diagnosis is made. Irrigation of the abscess-cavity with bichloride solution, 1 to 5000, or carbolic acid, 1 to 100, is indicated, unless drainage is perfect and no sepsis is present. In children the solutions may be weaker. The mortality from the empyema proper was 15 per cent. in personal cases. Earlier and more radical treatment would reduce it to one-half that proportion. J. A. Hartwell (*Med. News*, July 13, 1901).

The best method of securing counter-pressure and antisepsis at the same time is by the injecting of a saline solution through the one tube

Injectations of peroxide of hydrogen in 50-per-cent. solution puts a rapid stop to the formation of pus in the thoracic cavity, and has been strongly recommended as an injection in empyema whenever injections must be used. Editorial (*Jour. Respiratory Organs*, Sept., '89).

The safest method of procedure consists in replacing gradually the pleuritic exudate by an innocuous fluid: a solution (0.06 or 0.07 per cent.) of sodium chloride (common salt). After withdrawal of a small portion of the exudate the same quantity of salt solution is introduced into the pleural cavity. By repeating this operation several times, entire exudate may be replaced by saline solution. The injected liquid disappears by reabsorption as fast as the

lung dilates, and the consequences of a sudden diminution of the intrathoracic pressure need not be feared. S. Lewachew (*Times and Register*, Apr. 11, '98).

Immediate relief to syncope has been secured by the reverse action of the aspirator and the injection of the same fluid which has been drawn out.

The practice of aspiration in cases of empyema has still a great number of advocates, and it is probable that an attempt to evacuate the pleural cavity in this way is attended with good results when resorted to early in the progress of suppuration.

The packing of the cavity with iodoform or plain gauze in order to secure drainage has been advocated by Ransohoff, Laplace, and other surgeons. The experience of most practitioners is that a pleural sero-fibrinous effusion does not often degenerate into a purulent collection, and many attribute the pus to the failure of antiseptic precautions in aspiration.

In several cases the following points of interest were noted: Although the pleura had been full of fluid for twelve months, rapid re-expansion occurred. After thirty-seven tapplings the fluid became as clear as at first, in spite of admittance of air. The advice given in text-books to abandon paracentesis after two or three trials should be modified. There is no risk if the operator is careful to keep the instruments aseptic. West (*Brit. Med. Jour.*, Apr. 27, '95).

PARACENTESIS THORACIS.—Aspiration or simple puncture with a long hypodermic needle is performed as follows:—

1. The skin in the intercostal space selected is cleansed with soap and warm water, followed by alcohol, and a carbolic-acid solution of 6 to 100.

2. The needle is aseptitized by passing through an alcohol-lamp.

3. The skin is held up and the fact ascertained that there is space enough

between the upper surface of the rib and the course of the needle.

4. The needle is then suddenly plunged so as to penetrate the pleura.

5. After removal of the needle the wound is closed with collodion and cotton.

When a vacuum instrument cannot be secured, the surgeon should use devices at his command in preference to awaiting the more convenient forms of apparatus. He can attach a rubber tube to a trocar and cannula, if he is careful to hold the finger upon the outlet of the cannula as he removes the stylet. It would be well to insert a rubber tube into an antiseptic solution, so that the fluid may be carried into it, and no concern need then be felt as to the fluid ceasing to flow, when air would enter if the external orifice of the tube were out.

The exact directions in paragraph No. 3 are based upon the course of the intercostal artery, which is in a groove on the inferior surface of the rib, while the skin should be raised so that a valvular opening shall be made. When the needle is removed, the puncture is not open continuously and shuts out the air.

The thorough preparation of a patient even for so simple a procedure as aspiration, is necessary.

The best and most efficacious drug is strychnine nitrate injected hypodermically before an operation. The combination of $\frac{1}{25}$ grain of strychnine, with $\frac{1}{4}$ grain of morphine, $\frac{1}{150}$ grain of atropine, and $\frac{3}{4}$ grain of cocaine hydrochlorate, may be injected preparatory to aspiration.

The patient is placed on the sound side, and the arms folded over the chest, so as to draw the scapulæ away from the vertebræ. This affords a safe method of selecting the interspace between the sixth and seventh rib in the posterior

axillary line. It may be found at the extreme angle of the scapula, and with a space comparatively free from muscles, where the ribs are some distance apart. The most expedient course, however, is to count the ribs also, and to have a needle at least three inches in length which is attached to a Potain or Dieulafoy aspirator.

The most dependent portion of the collection should be selected in small accumulations.

The diaphragm has its lowest attachment behind at the twelfth rib and on the sides about the ninth or tenth, but the collection of pus may be incapsulated so as to present definite indications for puncture as low as the eighth intercostal space in the middle axillary line; behind this point, we may find the ninth intercostal space clearly dull, from fluid. In such cases the area of pulmonary resonance on the sound side should be carefully noted as a comparative guide.

The diaphragm has been shown to be higher, if possible, in some cases of empyema, on the affected side, than on the sound side. The organ will rise when the compression is removed; hence the advice of Stokes to go above the eighth interspace in cases of resection, incision, or puncture.

The sixth interspace in the midaxillary line or the eighth in the posterior axillary line near the border of the latissimus dorsi muscle and at the angle or point of the scapula is the point of selection of F. S. Dennis. The advisability of the three operations (thoracentesis, thoracotomy, thoracoplasty) depends upon the age of the patient, the character of the fluid, and especially, in the latter, upon the fact that it may be a life-saving operation. (Roswell Park.)

INCISION.—It is advisable to have all in readiness in cases where empyema is

suspected, and an exploratory puncture or aspiration is made, to incise at this point should pus be found to exist.

Especially is an incision necessary in cases where numerous punctures have been necessary to find the pus. It should be made where the needle is and before it is withdrawn. A groove may be made in the needle of the aspirator, as suggested by Kebbel, so that the blade can be started from this exact point as guided to the pus by the groove. All such incisions should be near the upper border of a rib.

There are five classes of cases in which surgical interference is to be considered:

1. Large cavities in which the lung, fastened to the vertebral column by thick false membrane, is entirely and permanently collapsed. In these cases the operation is useless and dangerous.
2. Large cavities in which the lung, though condensed, still preserves a slight vesicular murmur. Intervention is then sometimes useful, particularly in young patients and when the cavity does not extend beyond the third rib.
3. Cavities from eight to twelve centimetres in diameter; these present the most favorable conditions for cure.
4. Simply fistulous tracts of greater or less length; if short and straight, the results will probably be good; the prognosis becomes less favorable when the fistulæ are long and tortuous.
5. Cases in which there are moderate-sized cavities with fistulous tracts communicating with them; in these the prognosis is favorable. Bouilly (*Revue de Chir.*, Apr. 10, '88).

The method of simple incision in the intercostal space parallel with the ribs has been sufficient often to allow a drainage-tube to be inserted, and in this way many have found that the resection of ribs is unnecessary.

Free incision when done early is very successful; the removal of a portion of a rib is never necessary in acute cases,

and a fatal issue at any age is rather a result of the neglect to recognize the true nature of the case than of the operation itself. Lewis Marshall (*Lancet*, Dec. 21, '95).

Below the age of 23 it is unnecessary in empyema to remove portions of ribs, but above that age it is essential in order to insure contraction of the abscess-cavity. In urgent empyema it is best to use no chloroform, but to freeze the skin with chloride-of-ethyl spray. In patients above 23 portions of ribs may be removed whenever the breathing is sufficiently relieved to bear chloroform. J. C. Renton (*Practitioner*, Jan., '96).

Simple incision of the chest-wall, thoracotomy, may be employed, the site of the incision being determined according to the position of the collection of pus. An opening in the lowest part of the pleural cavity is not the most suitable. It is not advisable to wash out the cavity, at the time of operation at all events; such a procedure is not devoid of danger. The more efficient way of treating an empyema, especially in children, is to incise and remove a portion of a rib. A. Primrose (*Canadian Pract.*, Mar., '96).

Empyemata healed by expansion of the lung, ascent of the diaphragm, and contraction of the chest-wall. In all recent cases there is more or less complete re-expansion of the lung on the withdrawal of the pressure which has been exerted by the fluid. Full expansion in the lung should, therefore, be maintained at the time of the operation. J. E. Winters (*Prac. Med.*, Mar., '96).

Valved tube successfully used for draining the pleural cavity after incision in empyema, with the object of preventing the falling in of the chest-wall and diminished expansion of the lung. W. M. Hutton (*Lancet*, London, Feb. 6, '97).

Report based on seventy-five cases, observed chiefly in St. Mary's Hospital for Children. In simple cases the treatment was as follows: Excision of about one and one-half inches of the seventh or eighth rib in the posterior axillary line; light ether anæsthesia is usually employed; the purulent coagula are re-

moved; short rubber tubing, cut partly across, doubled and held by large safety-pins, is used for drainage; abundant gauze dressing is applied and changed when saturated. If the patient's condition contra-indicates general anæsthesia, an incision into the chest may be made between two ribs under eucaine anæsthesia. Aspiration is only used to give temporary relief to patients who are in great distress from the pressure of the fluid, or temporarily to relieve the second side of a double empyema after the first side has been opened. The patients are allowed out of bed as soon as practicable, and the expansion of the lung is encouraged by forced expiration. Irrigation is only used where there is a foul-smelling discharge from necrotic lung-tissue. Secondary operations are not done until good opportunity has been given for healing—usually three or four months should have elapsed after the primary operation—and if there should have been no noticeable improvement for a month. In the secondary operation the expansion of the lung should be encouraged by incising, stripping back, and, if necessary, removing portions of the thickened pulmonary pleura. The examination of forty-four cases at long periods after operation indicates that recovery is usually complete in the simple cases, and that there is surprisingly little deformity in most of the severe cases. Dowd (Medical News, Sept. 13, 1902).

Alfred Sheen, of Cardiff, Scotland, has been successful in securing permanent cures by the method that we have outlined above, and the consensus of opinion seems to be that the most radical measures are not indicated. When resection is practiced, a small-sized piece of rib, sufficient for one drainage-tube, has been found to answer all the purposes of drainage.

The most important and at the same time the most ingenious operation devised to accomplish this has been by Dr. Carl Beck, of New York. He uses an

elevator by which the rib may be cut and denuded of periosteum at the same time. The indication for the operation is, of course, in children, or those patients in whom a drainage-tube could not be inserted between the ribs. The indorsement of John Ashhurst, of Philadelphia, is very strong in favor of operative interference in cases of empyema, and the mortality he reports is especially small.

The practice of incision and drainage, of resection of ribs with the insertion of drainage-tubes, of the siphon-apparatus introduced by Bülau, all subserve the purpose intended.

Thoracotomy performed in 76 cases of empyema, of which 89 per cent. were cured; about 71 per cent. were able to work within two months. The point of election for the incision is the lateral surface of the thorax, just below the axilla, selecting the fourth, fifth, or sixth rib. A tube carried in at such point will always enter the free cavity, and, with the patient in the proper lateral position, allow the pus to flow out, a portion of the rib, about $1\frac{1}{10}$ inches, being previously removed. If disinfectant washes are indicated, salicylic or boric-acid solutions are preferred. A bandage covering the whole thorax is used, in connection with special movements of the body and rest in bed on the side, inclining to the back. Koenig (Pittsburgh Med. Review, Oct., '91).

Even if the operation for empyema does not effect a cure, it does not make the patient worse. In the large majority of cases operations give great relief, and in a certain proportion, particularly in the young, they give a perfect cure. Very rarely do they cause death. J. Ashhurst (Internat. Med. Mag., June, '94).

Costal trephining is simple of performance and harmless. Preferably performed on eighth and especially ninth rib in widest portion, posteriorly seven centimetres from costal angle. Crown of trephine one centimetre in diameter. Several openings may be made, either in

the same or adjacent ribs. Rey (Lyon Méd., June 23, '95).

In operating for empyema in children, circumscribing of the inferior and posterior borders of the healthy lung advised, followed by resecting, on the diseased side, the rib situated two or three centimètres above this limit, near the vertebral column. Schultz (Jahrb. d. Hamb. Staatskr., vol. xiii, p. 260).

Case of subphrenic abscess followed by empyema successfully treated by resection of a rib, drainage, and packing. McNaught (Brit. Med. Jour., May 22, '97).

Generally speaking, the case should be a law unto itself, and the surgical means at our command should be accompanied by early out-door exercise and gymnastic performances, especially in children and young adults. The deformity sometimes following the operation may be treated by Sayre's jury-mast, and by the ordinary remedies and measures for scoliosis.

SKYPHOSIS OR LORDOSIS.—Since 1883, Dieulafoy has practiced thoracentesis 180 times on 69 hospital patients and 200 times in his private practice, and never once has he seen the liquid become purulent after the operation. Whenever the liquid reached 1800 grammes (60 ounces) thoracentesis was imperative.

Treatment by irrigation of the pleural cavity is severely condemned by most authorities.

[The employment of irrigation in the cavity of the chest after the removal of purulent collection by incision or otherwise is a precarious measure. Even sterilized hot water has been attended with marked vital depression, amounting in some cases to collapse. The introduction of iodoform with glycerin by swabbing over the surface or upon gauze tampons within the pleural cavity is not attended with the inconveniences of general irrigation, and proves more effective in correcting septic development. J. McFADDEN GASTON, Assoc. Ed., Annual, '96.]

Number of cases of empyema with fistula treated by warm baths. If the fistulous opening is below the level of the fluid, it is evident that if the patient inspires and expires freely there will be a current of water into and out of the pleural cavity much stronger than can be obtained by simple irrigation. Clumps of coagulated blood and fibrinated masses are by this means washed out which could not have been removed by simple lavage. The baths were given in boiled water cooled to the temperature of the body, and lasted ten or fifteen minutes. The general condition of the patients was much improved, and no accident was observed to follow this treatment. Zeman (Rev. de Thér., May 1, '97).

Case of empyema in a child successfully treated by irrigation by submersion, according to Zeman's method, after resection. S. S. Adams (Pediatrics, July 1, '98).

Irrigation with a 4-per-cent. solution of bicarbonate of sodium used in a case of empyema in which incision, drainage, and lavage with boric-acid solution had failed to prevent reaccumulation of pus. Daily irrigation with the bicarbonate solution for five days effected a cure. L. Betances (La Rev. Méd. de Santo Domingo, Year 1, No. 2, 1902).

Authors agree in the following dangers in aspiration or irrigation of the pleural cavity, viz.: Hemiplegia, following cool solutions; death following aspiration; fatal results also in cases of the use of an anæsthetic; unusual depression from the sitting posture during aspiration, relieved by assuming the reclining position. The cautions given have been to use warm solutions, or, better, no solutions at all; and to stimulate with cognac, strychnine, etc., previous to thoracentesis.

[Richard H. Harte, of Philadelphia, has never had an unpleasant result from washing out an old empyema; but it must be remembered, he says, that a considerable number of cases are on record in which an injection, which may have

been frequently repeated without serious consequences, has led to sudden death, or to the most alarming symptoms, probably from the sudden increase of pressure within the cavity, caused by a partial closing of the outlet or by the use of too large a tube. The nature of the fluid employed can have had nothing whatever to do with these results, as equally bad results have followed the use of pure water. ("International Encyclopædia of Surgery," Ashhurst, vol. vii, Supplement.)

These results emphasize the risks attending intrathoracic irrigation. J. McFADDEN GASTON.]

INTERLOBAR PLEURISY.—This form is best treated by the excision of the fifth and sixth ribs, as shown in examples treated by Segond and others. The surgeons who have discovered interlobar pleurisies in time for treatment have generally made their resections too low. The autopsies in some cases showed Rochard's former statement correct in regard to their location.

Most published cases have recovered without operation, the pus having been expectorated.

Case operated on in which death occurred some days later, the pus being found between the lobes of the right lung. Gerhardt (Brit. Med. Jour., Sept. 9, '93).

CASES OF LONG STANDING with fistulæ, deformity, and great rigidity of the costal walls, may require what is known as the Letiéviant-Estlander operation, an operation first suggested by Letiéviant and practiced by Estlander. The operation has been variously applied to any resection of ribs for the purpose of the approximation of the walls of the chest. The most important distinction to be made, however, is that originally the operation included more than one rib and several inches of length in the resection.

[Frederick S. Dennis has awarded the credit of the first suggestion of resection of the ribs to Dr. Warren Stone, of New

Orleans, while Dollinger (Annual, '90) and others state that Letiéviant first suggested it.

The two suggestions were probably original so far as each of the above surgeons were concerned. Many operations have been done in this way, as seen in the case of W. W. Keen. J. McFADDEN GASTON, JR.]

The operation of Schede consists in the complete removal of the muscles and tissues adherent or attached to the ribs, with the exception of the skin, the fascia, and the parietal pleuræ, and these are stitched together and form the only protection to the chest at the point of the operation, and the only hope of restoring the tissue lies in the granulating process.

The incision is a U-shaped one, extending from the axilla in front downward to the limit of the pleura and backward and upward to the second rib, lifting the scapula in the removal of the bony flaps. This operation has been advised as a modification of Estlander's operation, in cases where the pleura is much thickened and where the walls fail to respond to ordinary means of reducing the cavity of the chest.

Estlander's operation—which consists in removing, not only a certain length or a certain number of ribs, but all the ribs lying in the wall of the empyema—performed twelve times, the results being nine cures and three deaths, one from tuberculosis, the second from cardiac disease, and the third from albuminuria. J. Boeckel (Revue Chir., Apr. 10, '88).

Extensive thoracoplasty by Schede's method performed in a case of thoracic empyema of twelve years' duration. Second operation performed three months after first. Recovery was without incident, though slow. Eight months after the second operation the wound broke open again and discharged a small quantity of pus. By a third operation some more of the chest-wall at the upper posterior angle was removed. A cavity three and one-half inches long and as

thick as the thumb was found. This was nearly obliterated by granulation-tissue. W. W. Keen (*Annals of Surgery*, June, '95).

One hundred and twenty-nine cases of empyema treated by resection of the chest-wall, in which 56.3 per cent. were healed, 20 per cent. improved, 3 per cent.

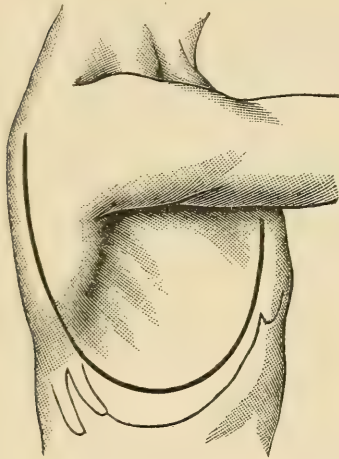


Fig. 1.—Schede's incision for thoracoplasty. (Keen.)

unchanged, and 20 per cent. died. There is little or no tendency to spinal curvature or to impairment of function of the corresponding upper extremity following these operations. Voswinkel (*Deut. Zeit. f. Chir.*, B. 45, S. 77).

Deformity observed resulting from removal of the fourth, fifth, sixth, and seventh ribs. This consisted of a large depression of the whole left side, beginning about two inches below the clavicle and extending below the free border of the ribs. There was a marked degree of lateral curvature. L. Emmett Holt (*Archives of Ped.*, Jan., '96).

In the treatment of empyema success obtained by removing the whole of the chest-wall covering the cavity (Schede) and breaking up and loosening of the contracted pleuræ (Delorme). Jordan (*Med. Record*, May 14, '98).

Christian Fenger, of Chicago, holds that there are certain cases in which Schede's operation is required; viz., after milder measures, such as incision, drain-

age, and Estlander's operation have been fruitlessly employed. He reported a successful case in which this operation was performed after other measures had been unsuccessfully resorted to during seven years.

Roswell Park, of Buffalo, states that the treatment of empyema should be based upon the same principles as are applicable to other abscesses. In acute cases presenting streptococci and staphylococci suppuration it may be sufficient in a few instances to simply aspirate. A summary of the treatment to be employed in cases of empyema may include the following features:—

(a) Prophylaxis.

1. Care should be taken to jugulate, if possible, all cases of incipient pneumonia, pleurisy, and bronchitis.

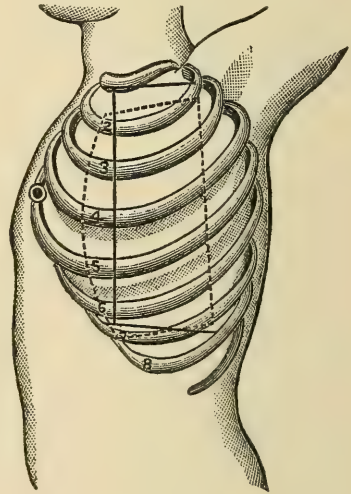


Fig. 2.—Schede's incision for thoracoplasty. The solid line shows the incision made by Keen. The dotted line shows the portion of the bony and muscular chest-wall removed. The posterior line should be farther back. (Keen.)

2. All penetrating wounds of the chest, whether from gunshot wounds or stab wounds, should be hermetically sealed.

3. Collections of blood-serum or air may be evacuated early by aspiration.

4. Children should be carefully examined in cases of continued fever, sweats, and hectic, and prompt measures taken to remove the possibility of purulent collections, by exploration.

(b) Operative treatment.

5. Incision and drainage.

6. Trap-door for exploration in cases of tuberculous deposits of caseous material.

7. Estlander's operation for the old and stubborn cases of fistulous empyema.

8. Schede's operation for thickened pleuræ, and resistance to the recourse to Estlander's operation or to Delorme's, Quénu's, or Gaston's modifications of flap-operations.

9. Iodoform or plain sterilized gauze tamponage for stimulating the granulation and securing constant drainage.

10. Permanganate-of-potash solutions for offensive discharges.

The successful results which have followed Estlander's and Schede's operations in certain severe cases of empyema have led some surgeons to take the too extreme position of advocating resection of the rib in all cases. Incision, the insertion of a drainage-tube, and irrigation with mild antiseptic solutions considered as the treatment most suitable for the great majority of cases. Edmund Andrews (*Jour. Amer. Med. Assoc.*, Mar. 4, '99).

PULSATING PLEURAL EFFUSIONS.—The term has been recognized for an empyema occurring, according to Tillmans, almost entirely on the left side. There have been sixty-eight cases collected, and these have occurred in the hands of a few men. The only mistake that might prove fatal could be to open a thoracic aneurism, thinking that it was an empyema. The general indications of empyema may be conclusively corroborated by an exploring needle or aspirator. The

treatment is the same as in any ordinary case of empyema.

TUBERCULAR EMPYEMA.—A large proportion of the cases of empyema are essentially cases of cold abscess, or, more properly, tuberculous abscess. In these, free incision, free drainage, and excision of a rib are required. Park has resorted to scraping with the sharp spoon, and in some he has cauterized the diseased surface with a 50-per-cent. solution of zinc chloride. In several cases death would



Fig. 3.—Result eight months after operation.
(Keen.)

have occurred had it not been for some such radical operation.

In tuberculous cases radical operation indicated—thoracotomy with resection—if exploratory puncture show bacteria of suppuration. If there are no bacteria of suppuration, aspiration advised to relieve pressure and allow the lung to expand. If the case is of long standing, and the compressed lung is inexpandible, palliative measures are indicated. Baumber (*Deutsche med. Woch.*, Nos. 37, 38, '94).

Tuberculous purulent pleurisy has been cured by thoracentesis followed by

injections of corrosive sublimate and boric acid through the same needle (or cannula) of a Dieulafoy or Potain aspirator.

To summarize the treatment of empyema, the following propositions seem tenable:—

1. Empyema is best prevented by promptly evacuating all considerable inflammatory effusions.

2. In the diagnosis of these effusions, by means of exploratory aspiration, the skin should be punctured by a tenotome at the point where the needle is to be driven in.

3. Serous effusions are best evacuated by aspiration. If they reaccumulate after the third evacuation, they should be subject to continuous siphon-drainage, the puncture being made by a small trocar and cannula, the latter being of such size that a small drainage-tube may be slipped through it.

4. Recent empyemata are best treated by continuous siphon-drainage, the tube being introduced through a cannula of at least the diameter of the little finger.

5. When, because of a narrow intercostal space or because of constant blocking with fibrinous material, siphon-drainage thus provided is inadequate, an inch of one of the ribs (usually seventh or eighth) should be resected, and a drainage-tube the diameter of the thumb should be used.

6. When the conditions are such that it is obviously impossible for the lung to expand under the influence of siphon-drainage and respiratory exercises, Delorme's operation of stripping the pseudo-membrane from the compressed lung should be attempted.

7. When Delorme's operation is impracticable, a resection of the ribs (Estlander) or of the chest-wall and thickened pleura (Schede), corresponding in extent to the size of the underlying cavity, is indicated. Edward Martin (Ther. Gaz., Aug. 15, 1900).

Decortication of the lung. In this operation the thickened pleura is removed from a lung, which in consequence of a pleural exudate has been more or less collapsed. It was first per-

sonally used in 1893. It is indicated for old empyemata, in which there is no tuberculosis of the lung and the patient has sufficient strength to withstand a major operation. It is a better operation than Estlander's, as by it there is a restoration of the function of the lung and a closure of the suppurating cavity.

The diseased pleural membrane is dissected away—not only that which covers the lung, but that portion lining the wall of the thorax and covering the diaphragm. The operation should be made as thorough as possible, and to this end a large opening in the chest is necessary. It should be so made as to admit of rapid closure after the operation, as this facilitates expansion of the lung, which is brought about by respiratory movements. Respiratory exercises should be employed in the after-treatment. G. R. Fowler (Med. News, June 15, 1901).

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ENCEPHALITIS.—Gr., ἐγκέφαλος, the brain, and *ιτις*, inflammation.

Synonyms.—Encephalitis; cerebritis.

Definition.—Inflammation may attack any portion of the brain, and in some cases nearly the entire brain is affected. It is probable that general inflammation of the brain never occurs, death ensuing before the inflammatory process invades the whole brain. Usually the inflammation is confined to a more or less circumscribed area in one lobe, but quite frequently it involves an entire lobe, less frequently all of one hemisphere, or large areas of both hemispheres; also it may exist as isolated or disseminated foci throughout the organ. No age of life is exempt from it, and a prenatal form is described. It is also frequently associated with meningitis.

Encephalitis may cause acute or chronic softening, the formation of pus, and complete disintegration of affected

parts of the brain; or it may cause an acute or chronic hardening of the brain, with or without atrophy, and, in certain rare cases, hypertrophy may exist. It is thus seen that the term encephalitis covers a wide range of clinical cases, and includes in its symptomatology an almost-endless combination of symptom-groups, which depend for their association upon the nature, grade, extent, and location of the inflammation within the encephalon, as well as upon many concomitant conditions which may exist in the patient. All of the symptom-groups have, however, usually some common characteristics, and, while accuracy in diagnosis is probably nowhere else more difficult, in many of the cases certain types of encephalitis have been described which show considerable uniformity. In the consideration of the subject it seems better to classify the cases upon what we know of their pathology, meagre as this often is, than to use the many etiological synonyms so frequently found in the older descriptions. In the present state of our knowledge certain terms commonly used are misleading to the student. This applies to the terms *polioencephalitis superior* and *polioencephalitis inferior*, introduced by Wernicke, and also to the *polioencephalitis* of Strümpell. These terms are widely used to denote some well-known types of focal encephalitis; but, since more recently many cases have been reported in which focal encephalitis involved both the gray and white substance, it would seem that such synonyms as proposed by Wernicke and Strümpell only serve to confuse, as remarked by Mills in his recent excellent work upon diseases of the nervous system. Encephalitis is often associated with meningitis, and the term "meningo-encephalitis" is applied to inflam-

mation of the membranes and subjacent brain-cortex.

Varieties.—For convenience of description encephalitis may be classified as follows:—

1. Acute non-suppurative encephalitis.

- (a) Focal.
- (b) Diffuse.
- (c) Disseminated.

II. Acute suppurative encephalitis.

- (a) Focal or circumscribed (abscess), single or multiple.
- (b) Diffuse.

III. Chronic encephalitis.

- (a) Terminal stages of cases arising acutely, but resulting in chronic cerebral lesions.
- (b) Chronic meningo-encephalitis.
- (c) Chronic softening due to encephalitis.

IV. Prenatal encephalitis.

Acute Non-suppurative Encephalitis.

Acute non-suppurative encephalitis occurs most frequently in infancy and childhood, but may occur at any age. Since the paper of Strümpell in 1884 much interest has been awakened in the whole subject of cerebral inflammation, and a considerable number of cases have been reported in which the autopsies have proved beyond doubt the existence of acute non-suppurative encephalitis as a distinct, primary affection. By some authorities it is held that acute non-suppurative encephalitis during foetal and infantile life is the prime factor in the etiology of a considerable proportion of cases of chronic degenerative diseases of the brain, including infantile cerebral paralysis, disseminated sclerosis, and bulbar paralysis. Observations, recorded since 1884, upon cases presenting the symptoms of acute encephalitis, tend to confirm this view; and it seems to be fairly established that acute en-

cephalitis quite commonly leaves residual affections, especially motor and psychical in character. Certain writers have affirmed a special tendency of acute non-suppurative encephalitis to attack the motor regions of the brain; but this may be only seemingly so, because of the great difficulty of observing defects of the special senses in children. While there are, undoubtedly, certain areas which, when they present an acute inflammation, give us more typical signs of its presence than do many of the so-called "silent regions" of the brain, one cannot review the post-mortem records, meagre as they still are, without concluding that acute inflammation attacks quite impartially the gray and white matter, the cortex and basal ganglia, the lining membrane of the ventricles, and the enveloping membranes of the encephalon.

Two forms of acute non-suppurative encephalitis may be said to exist clinically, according to the extent and distribution of the inflammatory process.

Acute focal non-suppurative encephalitis means a more or less circumscribed area in one lobe, or a number of inflammatory foci grouped together in one lobe or region of the brain.

Acute diffuse non-suppurative encephalitis may affect an entire lobe or hemisphere, or both hemispheres.

Acute disseminated encephalitis is so rare an affection that no clinical type can be described.

Symptoms.—The symptoms of acute non-suppurative encephalitis vary in their character according to the extent and intensity of the process, the cause producing the inflammation, and the particular region affected. In certain cases, however, the post-mortem examination failed to reveal lesions commensurate with the symptoms during life,

and the conclusion has been reached that, especially in those cases of acute non-suppurative encephalitis following influenza, typhoid fever, and the acute infections generally, there is a *toxic element* which not only intensifies the symptoms due to organic lesions also present, but is capable of causing a fatal termination in cases which after death may show comparatively-slight lesions. This intensification of the symptoms due to the primary toxæmia, may explain the rapid and complete recoveries which at times occur in the paralytic phenomena in such cases. Few cases, however, pass through an attack of acute encephalitis without some lasting mental or physical defect. The symptoms of acute non-suppurative encephalitis will be described according as the disease is *focal* or *diffuse*, although they have many symptoms in common.

(a) *Acute focal non-suppurative encephalitis* occurs most frequently in children, but cases are reported in adults, especially after influenza, and in alcoholics. The onset is usually sudden: after or during an attack of some acute infectious disease of childhood, or after influenza, diphtheria, typhoid fever, or, more rarely, after traumatism; there are headache, vomiting, fever, convulsions (single or repeated), irritability, and restlessness, with a tendency toward hebetude, or stupor. There may be an initial chill, or repeated chilly sensations may be complained of by the patient. When the disease arises during the course of some acute infectious disease the significance of the symptoms may be easily overlooked, or attributed to meningitis, until some form of paralysis makes the nature of the case clearer. The typical case, however, runs a more or less irregular course. Drowsiness is usually an early and a very characteristic

symptom, and this encephalonarcosis may persistently deepen, especially in rapidly-fatal cases, or it may alternate with periods of restlessness and delirium. In nearly all cases mental obtuseness is present, and in some cases there is also marked confusion of ideas, which may persist after the acute symptoms have passed away. The convulsions may be toxic or chronic, local or general, and are not characteristic of anything, during the acute stage, except as denoting a cerebral irritation. Rigidity of the spinal muscles and opisthotonos may occur, but the latter is much less frequent than in meningitis. The fever runs a moderate course, rarely exceeding 103° F. and subnormal variations are not uncommon, especially during the comatose states, which generally supervene rapidly after the acute onset. During the acute progress of the disease some form of paralysis may be noticed, or it may be almost the first sign in certain cases (see case reported by Putnam in the *Journal of Nervous and Mental Diseases*, '97), which begin usually less acutely than these cases occurring in connection with the acute infectious diseases. In other cases occurring during the height of an acute infectious disease, the paralysis may remain unnoticed until convalescence is well established, and the diagnosis of the case thus disclosed. The paralysis may take any form, and sensation may be affected, although few observations of this kind are on record. The paralysis may or may not be attended by spasm of the affected muscles. Atrophy is usually of limited degree when present at all, and Spitzka has observed hypertrophy of certain paralyzed muscle-groups. The location of the inflammation determines the form of the resulting paralysis. In the type of acute encephal-

itis described by Strümpell in 1884, and considered by him as strictly analogous to infantile poliomyelitis and the bulbar type of polioencephalitis described by Wernicke, it has since been found that the lesions quite commonly involve the white substance as well as the cortex. For this reason the writer concurs with Mills that the term "cortical encephalitis," while true of certain cases, is not as good as focal encephalitis, which can include all of these acute intracerebral inflammations, whether cortical, subcortical, or basal in location.

The sequelæ which have been noted in cases of focal encephalitis include paralysis, with or without spastic conditions; contractures, atrophy, epilepsy (often Jacksonian), hemichoreas, hemiathetosis, peculiar associated movements, and imbecility, all varying in degree according to the location, extent, and severity of the inflammation. When the process is confined chiefly to the cortex, the resultant paralysis may be monoplegic, hemiplegic, paraplegic, or diplegic, according to its extent. If ophthalmoplegia is present, which is sometimes associated with some degree of facial paralysis, the inflammation is usually found to involve the gray matter of the floor of the fourth ventricle, the aqueduct of Sylvius, and adjacent structures. This form corresponds to the polioencephalitis superior described by Wernicke, Thomsen, and others.

Another form also described by Wernicke and termed by him "polioencephalitis inferior" has *labio-glosso-laryngeal paralysis* as the chief clinical characteristic. In some cases of the latter form ophthalmoplegia may develop during the progress of the disease. The lesion of polioencephalitis inferior has been found in the motor nuclei of the post-oblongata and adjacent nerve-roots.

Some cases of acute focal encephalitis may begin insidiously, with very slight febrile reaction and gradual development of paralytic symptoms.

Case in which—after slight fever—"external ophthalmoplegia, cycloplegia, iridoplegia, and ptosis with diplegia facialis" and muscular inco-ordination developed within a period of two weeks, and after a course of ten days resulted in progressive and perfect recovery. Wolfe (*Jour. of Nerv. and Mental Sci.*, '94).

Case of a man in whom indistinctness of speech, followed by weakness of the movements of the lips, and difficulty in mastication were the first symptoms. There was then ptosis, diplopia; the knee-jerks were slightly increased; the eyes, aside from the paresis of the muscle, normal. Strychnine was steadily employed, with considerable improvement in the symptoms. The diagnosis was made of poli-encephalitis involving the motor nuclei of the pons and medulla, the bilateral character of the symptoms being the most important indication of central origin. Walton (*Boston Med. and Surg. Jour.*, Feb. 1, 1900).

This type of case is far more frequent in adults than in children, and corresponds exactly to the description by Wernicke of polioencephalitis superior acuta, with the exception that recovery ensued. Interesting cases of analogous symptomatology have been reported by Putnam and others, but our knowledge of the affection is mainly from the studies of German observers, including Strümpell, Wernicke, Oppenheim, Nauwerck, Brie, Freyhan, and others.

Very instructive case in a woman of 36, who exhibited loss of appetite, abdominal pain, slight fever, hebetude, rigidity of neck-muscles, dilatation of one pupil, coma, and death, with increased temperature. The post-mortem examination revealed numerous foci of hæmorrhagic softening throughout the substance of both cerebral hemispheres. Brie (*Allg. Zeit. f. Psych.*, B. 53, p. 604).

Case of poli-encephalitis in an adult in which a study of the clinical symptoms and the autopsical findings led to the following conclusions: (1) Landry's paralysis may be due to poliomyelitis; (2) the latter is an infectious disease, the inflammation being greatest in the anterior horns, but occurring also in the posterior horns, the white matter, and the meninges; (3) the symptoms are motor in type, because the disease is especially of the anterior horns; (4) meningitis is not uncommon in poliomyelitis; (5) poliomyelitis in the adult is essentially the same disease as poliomyelitis in the child; (6) it is related pathologically to the non-purulent form of encephalitis and to the poli-encephalitis of Wernicke. De Witt H. Sherman (*Phila. Med. Jour.*, Mar. 31, 1900).

This type is frequent among the reported cases.

[Nauwerck has reported several cases, one of which illustrates how rapidly fatal the disease may be. The patient in this case was a girl of 19, who presented the following symptoms: Headache, an unsteady or staggering gait, faintness, vomiting, loss of pupillary light-reflex, slow pulse, fever, hebetude with restlessness, and death on the following day. The autopsy revealed a focal encephalitis, surrounded by a zone of acute softening, and a bacillus identical with the bacillus of influenza was found in the lesion and also in the ventricular fluid. C. M. HAY.]

The symptom-group described by Strümpell differs from the Wernicke form of focal encephalitis in that paralysis of the external eye-muscles is present in the latter as a prominent symptom, and optic neuritis is far more commonly present. The other general motor disturbances, with impairment of speech, may be identical in the two forms. When ocular-nerve palsy is associated with polioencephalitis,—cases of which have been reported by Rothenthal, Seeligmüller, Guinon, Sachs, and others,—the affection is termed polio-encephalomyelitis. It is extremely rare,

does not occur in childhood, and runs a more or less subacute course.

These differing forms of acute focal encephalitis which have been referred to illustrate the chief clinical types of the disease. The most common of them is that occurring in infancy or childhood, after or during one of the acute infectious diseases. The next type in frequency is that occurring in adult life as a result of the poison of influenza, chronic alcoholism, or without apparent cause. The least frequent is the type due to traumatism, which more frequently causes a diffuse inflammation.

The part played by acute focal encephalitis in the etiology of the cerebral palsies of children is a question of much interest, and is as yet wholly undetermined. Osler believes that certain of the cases of sclerosis and porencephalus may be due to infantile meningo-encephalitis, and thinks that the views advanced by Strümpell have not met with the consideration which they deserve. J. Lewis Smith suggests that certain cases of infantile hemiplegia are due to cortical encephalitis induced by the toxin of cerebro-spinal fever. Jacobi favors the view that some cases of cerebral palsy in children, disseminated sclerosis, and bulbar paralysis are results of prenatal or infantile primary inflammation of the brain. The exact relationship, however, between acute focal encephalitis in early life and these forms of paralysis still awaits further pathological evidence.

It will be noticed that the symptoms of acute focal encephalitis are practically of the same character in the adult as they are in the child, although they are often less marked in the adult, and the residual paralyses and other affections above referred to are likely to be less severe. The reason for these differences in degree probably lies in the natural

differences which exist between the comparatively poorly developed foetal and infantile brain as compared with the matured organ. The brain, being the last organ to develop, during infantile life is softer and relatively more vascular, due to the larger proportion of water it contains; therefore it is not surprising that acute inflammation is far more frequent in infancy and childhood than during any other period of life.

(b) Acute diffuse non-suppurative encephalitis presents symptoms which in the acute stage closely resemble those attending the focal variety. They will, of course, vary with the location, extent, and severity of the inflammatory process. It occurs at any age of life, but the cases are more numerous below the age of twenty, according to the statistics of Knaggs and Brown. This form of cerebral inflammation may be rapidly fatal, or it may run a subacute course, finally ending in a chronic condition. Complete recovery is exceedingly rare, but partial recovery is not uncommon. It occurs most frequently after traumatism, as the exciting cause. The cases occurring in adult life are commonly due to alcohol, syphilis, or traumatism. Cases also occur in which it is impossible to assign a definite cause; but it is probable that, as infection is an important cause of focal encephalitis, it is also a more or less frequent cause of the diffuse form of the disease. Although there is little regularity in the appearance of its symptoms, the onset of acute diffuse non-suppurative encephalitis is apt to be marked by dull or boring pain in the head, fever with delirium or stupor, local or wide-spread muscular spasm, and some form of paresis rapidly increasing to paralysis, usually spastic in character. Mental hebetude, or tor-

por, appears early, and throughout the disease is a very marked feature. The reflexes are increased in the paralyzed parts. Sensation is affected according to the seat of the lesion. The temperature may be subnormal on the paralyzed side in hemiplegic cases. Optic neuritis, which may be present, is not so frequent as in suppurative meningitis or encephalitis. Localized muscular tremblings frequently occur early, and may be the first symptom. These spastic movements may affect any portion of the body, but more frequently one arm or the muscles of the face and neck. Cases are reported in which there has been incessant spasm of the facial muscles, the tongue, the ocular muscles, and the muscles of mastication. With these spastic features general convulsions may occur, which may be repeated. The pupils are contracted or unequal. If the patient survives the acute stage, apathy and stupor become more marked. On arousing the patient great mental degeneration is apparent. The evacuations are voluntary. The temperature falls and a subnormal range is common. The disease runs a course of from a few hours to five or six weeks. Most cases run several weeks. Some cases partially recover and continue to live with chronic conditions of paralysis and mental disease. Certain cases of acute delirious mania exhibit post-mortem the lesions of an acute diffuse non-suppurative encephalitis.

(c) Acute disseminated non-suppurative encephalitis has no distinct clinical existence. It may occur as a result of syphilis, or during the course of the acute infectious diseases, as typhoid and typhus fever, erysipelas, scarlet fever, diphtheria, small-pox, influenza, septicæmia, and pyæmia. Pathologically, small foci of inflammation appear quite early distributed throughout the brain.

Colonies of micrococci have been found scattered throughout the brain. This condition has been termed *mycosis* of the brain. The symptoms produced by these lesions must vary indefinitely with their number and distribution. The cases reported are too few to base any clinical description upon.

Although acute non-suppurative encephalitis has been established as a clinical type by the studies of many well-qualified observers, its etiology is still largely a matter of speculation. It is true that we know something of the conditions favorable to its development, but why the affections which give rise to it at times are not more frequently followed by this disease, when it is considered that they are very common diseases, is hard to explain. It can be stated that at present we are almost wholly ignorant of its primary causative factor, and the exact mode of production of the inflammatory lesions.

Etiology.—Acute non-suppurative encephalitis in its focal manifestations most frequently occurs in connection with some acute infectious disease. It may arise during the progress of the infective process, or days or weeks after convalescence has been established. The diseases with which it has most frequently been associated are influenza, the acute infectious diseases of childhood, typhoid fever, and diphtheria. Certain cases occur in which these infections are absent. This fact has been explained by some writers upon the subject as pointing to the probable existence of a definite toxin peculiar to the disease. Leichtenstern and Nauwerck believe that the focal-hæmorrhagic form of acute encephalitis may be of bacterial embolic origin. The latter observer, with Pfuhl and many others, think that the nervous symptoms may be the first sign of the in-

fection. Traumatism may be a cause of both focal and diffuse encephalitis, but is far more frequently causative of the latter. The same may be said of alcohol and syphilis.

Acute non-suppurative encephalitis of all varieties is far more frequent under the twentieth year of life, and the majority of cases of acute focal encephalitis occur during infancy and childhood. After the age of twenty alcohol, syphilis, traumatism, and the influenza infection are the chief causes recorded. It has also been known to follow sun-stroke.

Pathology.—The few autopsies which have been made in cases of acute non-suppurative encephalitis show in the acute focal lesions the presence of the ordinary appearances of acute inflammation of brain-tissue, and very commonly associated with numerous punctate hæmorrhages within the affected areas. The patches may be small, single or multiple, and either confined to a small portion of one lobe or more or less diffused throughout one region of the brain. Macroscopically the acute lesions are reddish gray in color, of diminished consistence, sometimes amounting to acute red softening, and are surrounded usually by an area of increased vascularity, showing lesser degrees of the inflammatory process until normal brain-tissue is reached. In some cases the process is sharply defined, but no distinct limiting membrane has been described. The hæmorrhages, which are common in these cases, are usually small and punctate in form, but may be large and attended by disintegration of the brain-tissue in their immediate neighborhood. Microscopically these lesions present the evidences of an exudative inflammation. The vessels are seen to be ruptured here and there, an exodus of leucocytes is seen especially marked

about the vessels and often distending the perivascular lymph-spaces, while granular cells are apt to be present.

Upon microscopical examination in acute cases of this kind, aggregations of large round or angular epithelioid cells constantly found; these cells exhibit a great tendency toward fatty degeneration. Friedmann (*Neurologisches Centralblatt*, Aug. 1, '90).

The parenchymatous changes are probably secondary to the vascular lesions, and broken-down cells and disintegrated nerve-fibres are seen when the inflammatory process has progressed far enough to destroy these elements. The rôle of the infecting microbes in the cases arising from infectious diseases is still a question. Whether they operate directly from the blood upon the tissues or whether the lesions are due to some toxin generated by them is undetermined. When basal structures are attacked, the cranial-nerve roots have been found to be affected by inflammatory changes resulting in degeneration or softening. The membranes are frequently implicated when the inflammation is cortical, and may present bright-reddish patches due to distended vessels and minute hæmorrhages.

The post-mortem appearances of the diffuse form of acute encephalitis do not differ markedly from the localized form except in the greater extent of the lesion. During its acute stage there are the same macroscopical appearances and the brain is softened. In some cases, in which the inflammatory reaction is less severe and of longer duration, the brain undergoes hardening, which may involve a lobe or an entire hemisphere. In these cases of diffuse inflammation implication of the membranes is not uncommon. In most cases of diffuse encephalitis some degree of softening is the rule. Microscopically during the acute stage

the vessels are dilated, capillary hæmorrhages are frequent, and the brain-tissue is infiltrated with leucocytes, which also distend the perivascular lymphatic sheaths. Compound granular cells appear, with secondary degenerative changes in the nerve-cells and axis-cylinders, with active proliferation of the neuroglia. This process progresses at times until the nerve-elements are more or less completely destroyed in the affected area. In cases where hardening takes place both gray and white substances may be involved, but it has been especially marked in the white substance. Pathologically, the hardening is due to increase of the connective tissue, especially the vascular connective tissue. In one of the cases collected by Knaggs and Brown, the white substance of both hemispheres was found very much hardened, while the cortical substance was so soft as to be easily washed off by a stream of running water, giving the appearance afterward of a plaster cast of the encephalon.

Diagnosis.—The recognition of acute non-suppurative encephalitis during the period of its inception must, in nearly all cases, be attended with difficulty. This is particularly true of cases occurring in infancy and childhood, where it most frequently occurs as a complication or sequel of some of the acute infectious diseases. Very often it is not until the development of some form of paralysis that the disease is suspected to exist, and only the most careful study of each individual case can separate this affection from meningitis, with which it is, no doubt, frequently associated. This is especially apt to be true in traumatic cases. In all cases in which, during the progress of some acute general disease cerebral symptoms arise, in which, after a period marked by moderate signs of

cerebral irritability, there results a paralysis out of proportion in severity with the general symptoms which might be expected to be present in meningitis, and, if other obvious exciting causes of the latter can be excluded, the presumption would be in favor of encephalitis. While no rule can be made with any degree of certainty, it is probable that premonitory symptoms are far more common and last a longer period in meningitis before stupor and coma supervene. Photophobia, intolerance of light, and retraction of the head are often persistent in meningitis for days and even weeks before the stage of coma is reached. In all recorded cases of acute non-suppurative encephalitis the tendency to dullness, apathy, stupor, or coma is a marked and often early feature. The presence of optic neuritis favors meningitis, while its absence is wholly without diagnostic significance.

The best guide to a correct diagnosis, in cases where this is possible, between acute focal non-suppurative encephalitis and the different forms of meningitis is a careful study, not of any particular symptom-group, but of the entire case. There is no absolutely diagnostic sign by which they can be clinically separated, but a careful review of the onset, course, and succession of the symptoms will afford more valuable information than will any study of particular symptoms. Thus it will be borne in mind that both affections are very rare complications of the acute infectious diseases, but that meningitis is the more common; that any local source of septic infection, rheumatism with endocarditis, adjacent disease of the cranial bones, erysipelas, and septicæmia, more frequently cause meningitis; and that after traumatism meningitis usually develops at once or within two or three

days, but the signs of encephalitis usually do not appear until considerably later. In this connection it may be mentioned that cases of acute encephalitis, from severe concussion upon the opposite side from the point of reception of the injury, have been reported.

In cases running a subacute course the decided mental deterioration with long spells of extreme torpor or even semicomatose states, and persistent spastic paralysis, have been the salient features of certain reported cases of diffuse non-suppurative encephalitis. Cases of spastic hemiplegia and diplegia in children quite frequently will give a history of an initial illness attended by convulsions, coma, and fever, and it is probable that a number of these cases arise from acute non-suppurative encephalitis during infancy. The same may be said of certain cases of disseminated sclerosis and bulbar paralysis. The trend of opinion seems to favor inflammatory lesions as causative of many of the chronic degenerative diseases of the brain met with in adult life. Further pathological proof is needed to establish the diagnostic features of acute inflammation of the brain in early life. In all cases of inflammation of the brain after traumatism the possibility of a non-suppurative diffuse encephalitis should be borne in mind. The diagnosis of the disseminated type can at present be little more than conjectural.

Prognosis.—The prognosis of any form of acute non-suppurative encephalitis is grave, both as regards life and the outlook for perfect recovery. In all forms many cases die during the acute attack. The prognosis of acute focal non-suppurative encephalitis depends, in great measure, upon the severity of the acute primary infection with which it is most frequently associated, and of

which we must at present regard it as a resultant. Cases of perfect recovery from paralysis following this form of encephalitis are not uncommon, and the paralysis in these cases generally shows improvement for a year following the attack. After influenza, especially, this tendency to recover from apparently grave conditions is marked. Very few cases, however, recover perfectly.

The prognosis of diffuse non-suppurative encephalitis in its acute form is very grave, both as regards life and recovery from residual lesions. There is almost no hope of complete recovery in any case. Cases having both hemispheres involved generally die within a few days. The majority of cases which run a subacute course may live a number of months, or with crippled intelligence and paralyzed bodies live for years. In general terms, cases of acute non-suppurative encephalitis, which begin abruptly, with decided fever, a rapidly-increasing comatose condition, and extensive paralysis are apt to be rapidly fatal; and, conversely, cases beginning rather insidiously, with slow development of symptoms, offer more hope of recovery. All grades of acute non-suppurative encephalitis are subject to irregularity in course and symptoms, so recovery sometimes occurs from apparently hopeless conditions; therefore an absolutely fatal prognosis should not be given in any case.

Treatment.—The treatment of acute non-suppurative encephalitis will vary somewhat according to the age of the patient, the previous state of health, and the existence or not of some acute infectious disease; but the same general principles which govern the treatment of acute simple meningitis apply to all of these cases; absolute rest in bed in a darkened and well-ventilated room is

necessary in all cases. The head and shoulders should be elevated. Absolute quiet on the part of the attendants, and the exclusion of any source of mental irritation or excitement should be rigidly enforced. As soon as the existence of the disease is suspected, local depletion, by means of dry or wet cups or leeches, applied to the nape of the neck or behind the ears, or to the temples; or general depletion by venesection in healthy sthenic adults with severe onset, should be practiced, followed in all cases by the ice-bag to the head. A fly blister may be applied to the occiput, and is better than larger blisters applied extensively over the head. When there is much hair the scalp should be shaved to admit of the fullest effects of dry cold. When vomiting is present small pieces of ice may be given by the mouth with sips of cinnamon-water at times, and a mustard plaster should be applied over the epigastrium; or a turpentine stoop may be used over the whole abdomen occasionally for this, and for its derivative effect. At the same time small and frequently repeated doses of mercury, preferably calomel, should be administered by the mouth, followed by a brisk purgative, and succeeded by the continued administration of smaller doses of mercury at longer intervals. In suitable cases aconite or veratrum viride may be given during the onset until their full physiological effect is secured, but in cases in children already weakened by disease they should be cautiously employed.

For the control of pain some form of opium is necessary, and where there is active delirium and marked local or general tremblings or irregular tremor, it may be combined with chloral and the bromides. The continuous application

of dry cold should be maintained during the acute stage.

The diet should consist of milk or other light nutritious preparations in small quantities, and they may be predigested artificially with benefit. No stimulants should be given unless urgently demanded by the condition of the pulse. Cases demanding stimulation in the early days of the disease may be given strychnine, supplemented by small doses of alcohol or ammonia in some form. The essence or wine of pepsin or champagne are acceptable stimulants to children, and are better borne by the stomach than whisky or brandy. If the patient cannot swallow, nutritive enemata should be given.

Should the patient survive the attack, and the case continue in subacute forms, treatment must be directed to nourishing the patient, to improvement of the general condition, and toward increasing muscular power in paralyzed parts. These indications are to be met by careful and systematic feeding of light and easily-digestible articles, by massage, faradization, and Swedish movements of affected members to prevent contractions.

Acute Suppurative Encephalitis.

Acute inflammation of the brain terminating in the formation of pus may be a focal or circumscribed process, in which single or multiple areas are affected; or it may be a diffuse process affecting large areas of the cortex, often with implication of the adjacent membranes, or larger or smaller areas of the brain-substance may be involved, often including the lining membrane of the ventricles. The majority of cases of abscess of the brain are inflammatory in origin, so that acute suppurative encephalitis in its circumscribed or focal form is practically synonymous with

cerebral or encephalic abscess. Certain cases of abscess may occur without any evidence of an inflammatory genesis. They are, however, due to necrotic softening and do not come under consideration here, as they are considered under **CEREBRAL ABSCESS**. Practically, inflammation of the brain, in its suppurative form, occurs as a focal or diffuse disease, and the former is *clinically* abscess of the brain, while the latter is most common as a diffuse meningo-encephalitis. These affections, although closely allied, for clearness of description will be considered separately.

(A) Acute Focal Suppurative Encephalitis.

Synonyms.—Abscess of the brain; encephalic abscess. (See **CEREBRAL ABSCESS**.)

(B) Acute Diffuse Suppurative Encephalitis.

Definition.—Diffuse suppurative encephalitis, as the term implies, is a diffuse infective inflammation involving large areas of the brain, often with coincident involvement of its membranes, and resulting in pus-formation.

Symptoms.—The symptoms of this condition are those of cerebral irritation and compression of large and irregular areas of the brain. The signs present point to a septic process. The pulse, temperature, and respiration are irregularly affected; sudden variations in all three frequently occur. Chills or rigors may be a marked feature. The symptoms in addition which are present in whole or in part in such cases are dull and deep pain in the head, stupor with attacks of delirium, irregular local or general convulsions or paralysis, optic neuritis, various forms of aphasia, anæsthesias or paræsthesias of irregular distribution, oculomotor palsy, various disorders of vision, or of other special senses, accord-

ing to the region of brain involved. The patient may die within a few days or a week, especially in cases due to severe head-wounds, fractures, or lacerations of the brain-substance. In such cases an extensive leptomeningitis is commonly present in addition. In other cases the acute symptoms pass away and leave the patient in a condition of great torpidity, with pain in the head, spastic or chronic paralytic phenomena, occasional convulsions and progressive loss of function in those parts supplied by the affected part of the brain. In some cases patients may linger for months with hopeless mental deterioration, extensive motor and sensory paralysis, and partial or complete destruction of some of the special senses. Death in these cases finally results from exhaustion.

Etiology.—This form of suppurative encephalitis follows, at times, severe injuries, or it may be a complication or a sequence of one of the acute infectious diseases. It has the same general etiology as the focal form of suppurative encephalitis, already referred to. It is never primary.

Pathology.—Post-mortem examination reveals large areas of disorganized, pulpy, soft, or even semifluid consistence of the affected portion of the brain. The adjacent membranes are likely to be involved, and may be softened, deeply congested, and covered with purulent exudate, which may also fill up the sulci and large fissures of the organ. In cases running a subacute course, the membrane may be considerably thickened, with breaking down of their cerebral surfaces. Microscopically there is the pus-cell, massing of leucocytes around the borders of the process, dilated vessels and perivascular spaces, and within the area of utter destruction are seen compound granule-cells, granular *débris*,

and the remnants of nerve-cells and fibres. Any of the pathogenic bacteria mentioned under acute focal suppurative encephalitis may be present. The bacillus communis coli has also been observed by Howard.

The infection followed a suppurating rectal wound, the child presenting very interesting congenital malformations of the heart, with imperforate rectum. The post-mortem lesions in this case were acute purulent ependymitis and encephalitis (the ventricles being distended with pus), with basic and cortical meningitis. The pus was creamy, yellow green in color, and a micrococcus was present in it as well as the bacillus communis coli. Howard (Johns Hopkins Hosp. Bull., vol. iii, p. 59, '92).

In some of the cases running a chronic course the brain-destruction may be very great, and an entire hemisphere or even more of the brain be destroyed, and present at the autopsy a semifluid and purulent mass.

Diagnosis.—The diagnosis is made by a study of the cause producing the condition, the very grave nature and the decidedly septic character of the cerebral and general symptoms, the irregularity of its course, and the irregular and widespread impairment of motor, sensory, or special-sense functions, according to the region affected. When in conjunction with purulent meningitis, the condition affecting the brain-substance can only be suspected by the intensity of the symptoms present, and their mode of onset, the grave set of paralytic symptoms with mental confusion or deep stupor, often succeeding the most acute manifestations of the meningeal inflammation.

In some cases in which post-mortem examination reveals a large region of the brain converted into pus, and especially in those cases where the clinical history was one of gradual loss of motor or sen-

sory functions, with loss of memory, confusion of mind, without any period of active inflammatory symptoms being traceable, the condition has been called "cold abscess of the brain." It is more probable that such cases should be placed in a distinct class and that the fact be recognized, as pointed out by Gowers and others, that there is this form of softening which depends essentially upon a slow chronic form of encephalitis. These cases, however, are quite rare, and are more often encountered, probably in hospitals for the insane than in civil practice. It is apt to occur in advanced life, at least after the age of forty.

Prognosis.—The disease always terminates fatally, although some cases last several weeks.

Treatment.—Little need be said of treatment, which must usually be expectant and symptomatic. Cases presenting signs of superficial pus-conditions should have the benefit of trephining. Trephining with drainage of the ventricles may also be practiced in cases where the ventricles are distended with pus and signs of compression are great. Some cases of this kind have been reported, in which free collections of pus in the cerebral fissures have been evacuated and drained with success, so that in all cases in which a diagnosis can be made the operation should be performed.

Chronic Encephalitis.

The term "chronic encephalitis" has an indefinite and vague meaning, because it has been applied by different writers to a number of pathological states. As a clinical type, rare cases exist which present, post-mortem, a diffused general sclerosis of evident inflammatory causation. These cases are rare, and the symptoms observed during life are very variable and their significance is rarely apparent during life. Sele-

rosis is, according to some authorities, always primarily an inflammatory process. If this be assumed, then the pathology of almost all chronic brain diseases would have chronic encephalitis as their prime causative factor. Considerable doubt, however, exists as to the essential nature of ordinary cerebral sclerosis, and positive proof is lacking. In gouty patients, according to Gowers, a chronic focal inflammation of the cortex may exist and simulate brain-tumor, and optic neuritis may be present in addition to focal symptoms. Hughlings-Jackson and others also have reported cases of seemingly primary chronic encephalitis; but the cases are too few to need a separate classification. In some of these cases hypertrophy of the cortex has been noticed.

Definition.—In the present state of our knowledge, chronic encephalitis may be defined as a term which is used to denote several pathological states, but is applied more especially to cases in which there is great increase in the connective-tissue elements, resulting usually in hardening of the brain, with secondary degenerative, nutritic, and functional changes in the nerve-elements, and may rarely produce a state of chronic softening.

Varieties.—The following types may be said to show greater or less degrees of chronic encephalitis.

(a) Terminal stages of cases arising more or less acutely, but resulting in chronic cerebral lesions.

In this class may be included those cases presenting residual symptoms, lesions of focal and diffuse non-suppurative encephalitis, the zones of dense connective tissue, proliferation surrounding old cases of embolism, thrombosis, abscess and tumor, the secondary reactive sclerosis found in cases of spastic paral-

ysis, and the sclerotic patches of disseminated sclerosis, insular sclerosis, and the syphilitic forms of the same affecting the brain often in conjunction with a similar spinal lesion. All of these pathological states are essentially of the nature of a chronic inflammation, and in all of them the vascular connective-tissue element predominates, to the impairment or destruction of the parenchymatous brain-tissue. The symptomatology of all of the above lesions, of course, differ widely according to the site of the lesions, but the chronic encephalitis undoubtedly is a factor in these and many more, which readily suggest themselves to the mind of the student of nervous diseases, in which the sole persistent lesion is a sclerosis which is of undoubted inflammatory origin.

(b) Chronic meningo-encephalitis. This is the distinctive lesion of paralytic dementia, and for our knowledge of its minute anatomy we are chiefly indebted to the studies of Bevan Lewis. The brain-cortex and the pia mater are involved in the process. It may also effect the brain to a considerable depth, varying in different convolutions, and ependymitis is frequently also present. Raymond considers the starting-point of the disease in syphilitic subjects to be in the walls of the capillary blood-vessels of the cortex. Bevan Lewis recognizes three stages to chronic meningo-encephalitis, which he gives as follows: 1. Stage of inflammatory proliferation in the tunica adventitia of the arterioles, with special nuclear proliferation, alterations in the calibre of the vessels, and secondary trophic changes in the surrounding tissue. 2. Stage of development of the lymph-connective system, with degeneration and loss of nerve-cells and fibres. 3. Stage of fibrillation of connective-tissue elements, together with

great atrophy of the affected portion of the brain.

On removing the calvarium, in these cases, it is noticed that the dura is generally more or less adherent, the cerebrospinal fluid is increased, the meshes of the pia mater are œdematous and fill up the solei all over the cortex, especially in the motor area and over the postero-parietal region. The cortex and membranes are adherent; so that often the cortex is lacerated on removal of the membranes. Marked atrophy of the convolutions is nearly a constant feature. The cortex is harder than normal. On section the thickness of the cortex is diminished, and in places no clear demarkation exists between the gray and white matter. There is ventricular dilatation and granular ependymitis. All of these changes are especially marked over the frontal and parietal regions.

Pathological findings analogous to the above are also observed in some cases of chronic epilepsy, and in certain types of chronic dementia; but this pathological combination is so uniform and striking in paralytic dementia that it has been accepted unanimously as the lesion of that disease, and by some writers, including Osler, the term "chronic meningo-encephalitis" is used as synonymous with "general paralysis of the insane."

The symptoms, etiology, diagnosis, prognosis, and treatment of this condition need not be referred to here, since they will be found in the description of paralytic dementia, which is here only taken as the most prominent type of chronic meningo-encephalitis, but not as the sole condition in which this lesion exists.

(c) The consideration of forms of chronic softening due to chronic encephalitis need scarcely be mentioned, since the evidence upon which their

pathology rests is too meagre. The existence of such cases has, however, been mentioned by Gowers and others, but the writer has been unable to find the accounts of any post-mortem examinations bearing upon the subject. The chronic state of diffuse or focal suppuration has been referred to as a sequel to an acute inflammation.

Symptoms.—The symptoms of chronic encephalitis will depend upon its variety, etiology, location, and the grade of the process, as will readily be appreciated when the wide range of clinical cases in which this lesion exists is considered. Reference has been made to the types described by Hughlings-Jackson and by Gowers, in which more or less severe signs of cerebral irritation existed for months, with slight fever, and sometimes spastic neuritis, especially in those cases having head-pain, vomiting, and focal signs simulating those of tumor.

In all cases in which chronic encephalitis exists as a complicating or reactive inflammatory condition, its symptomatology is essentially that of the primary condition giving rise to it. This refers to cases of brain-tumor, abscess, embolism, thrombosis, foreign bodies implanted in the brain, exostoses of the cranial bones inflicting pressure upon the brain, or calcareous growths developed within the cerebral membranes. Chronic encephalitis enters also into the pathology of syphilis and chronic alcoholism.

For the symptoms caused by chronic meningo-encephalitis—or "periencephalitis," as preferred by certain writers—the reader is referred to the article upon paralytic dementia, or general paralysis of the insane; while essentially the same lesions occurring in some cases of chronic epilepsy and of terminal dementia do not give rise to any constant clinical type.

It is thus seen that the study of the

clinical symptoms which may arise upon the pathological basis of chronic encephalitis are many and varied, and can only be studied as types, some of which have been indicated as most clearly proved to exist as results of an inflammatory lesion.

Etiology.—The primary etiological factor in cases of chronic encephalitis is, excluding syphilitic cases, almost always obscure, and the exact nature of the primary irritant, which we must assume as causative, is still a subject for future investigation. There is, in certain cases, probably an hereditary predisposition or weakness of the cerebral vascular system, owing to which the changes in the perivascular connective tissue occur from causes insufficient to produce them in the ordinary brain. This hereditary factor in etiology is hard to prove, but is frequently suggested in the clinical study of the cases.

The obvious predisposing causes of chronic encephalitis are those common to very many diseases of the brain, and include syphilis, embolism, traumatism, excessive physical or mental labor, anxiety or worry, fright, the acute infectious diseases; organic affections of the kidneys, liver, or heart; and others.

There is little doubt that prolonged mental overwork, especially if associated with prolonged anxiety, is capable of leading to pronounced vascular disturbance in the cerebrum, thus furnishing the conditions upon which the inflammatory process may be readily ingrafted.

Pathology.—So far as is known, the primary changes in chronic encephalitis occur in the vascular (mesodermic) connective tissues, and other structures are coincidentally—or, more usually, *subsequently*—attacked. In syphilitic cases the specific irritant toxin probably acts upon the nerve-cell, the neuroglia, the

lymph-connective system, and the vascular and perivascular tissues; and it is further probable that one or other of these elements suffer more or less in different cases, and that this explains in some degree the wide range of syphilitic brain-symptoms. It would appear, however, that chronic encephalitis from all causes is usually of primary vascular origin, the pathological and clinical evidences both supporting this view.

Post-mortem examination in cases of chronic encephalitis reveals most commonly atrophy of the affected part, with hardening of the tissues; very rarely it has revealed hypertrophy of the convolutions as a result of the inflammation; according to the observations of Gowers, a type of chronic encephalitis exists in which no macroscopical change can be noticed after death, but in which "slight diffuse inflammatory changes were found throughout the brain-substance on microscopical examination." In certain other cases the same authority affirms that chronic encephalitis may cause a form of chronic softening, which has already been referred to in this paper.

The microscopical appearances differ according to the stage of the process, and have already been sufficiently referred to in describing the varieties of the disease.

The real significance of all of these chronic changes remains the subject of dispute, and able authorities on either side contend, on the one hand, for the inflammatory origin of the lesions described, while, on the other, degeneration is held to be the first step in the process. It seems, however, to the writer that the term "chronic encephalitis," according to our present knowledge, should include the clinical states to which reference has briefly been made, and that the theories of agenesis and degenera-

tion are very satisfactory as applied to a great number of other chronic brain conditions, which present analogous lesions, but in which no inflammatory stage is known to exist. Continued and careful clinical and pathological evidence is needed to limit strictly the meaning of chronic encephalitis, or positively to extend it so as to exclude more of these sclerotic lesions than at present we are justified in applying to it.

Diagnosis.—The diagnosis of chronic encephalitis is made from the presence of one or other of its causes and the association of its symptoms. According to Gowers, in rare cases of chronic encephalitis, chronic headache with long-continued cerebral symptoms, including optic neuritis, may simulate tumor of the brain. Hughlings-Jackson has reported a case in which such symptoms existed for six months. These symptoms in these rare cases of primary chronic encephalitis may be headache, vertigo, epileptic attacks, transient loss of sight or other special senses, vomiting, optic neuritis, slight fever and stupor, followed by coma and death. The diagnosis from tumor would be made by noting the want of progressive nature of the lesion, commonly present in tumor, the general character of the head-pain, and other symptoms of cerebral irritation, and the more definite focal symptoms of tumor would also be wanting.

The forms of chronic encephalitis surrounding new growths or other focal lesions need not be discussed, because their diagnosis is that of the primary condition practically.

Chronic meningo-encephalitis does not present any very distinct clinical type, except when present as the lesion of paralytic dementia.

Prognosis.—In all forms of chronic encephalitis the prognosis is very grave;

in most cases absolutely hopeless as regards cure. All cases of paralytic dementia end fatally, except in extremely rare instances, in which a remission lasting many years may occur. The acute forms of chronic encephalitis which have been mentioned may run prolonged courses, and death may result from intercurrent disease, but is more usually due to the brain condition directly or indirectly.

Treatment.—The most hopeful cases of chronic encephalitis clinically are those resulting from syphilis. In such cases large doses of the iodide of potassium combined with rest and general tonic treatment sometimes accomplishes extremely satisfactory results. The rare cases in which chronic encephalitis is suspected as a primary condition must be treated on the general principles governing the treatment of chronic inflammation. The cases associated with other focal cerebral lesions require the treatment necessary to the primary condition present.

Prenatal Encephalitis.

The basis for belief in a prenatal form of encephalitis is chiefly the studies of Virchow, who described in 1865 whitish or yellowish-gray foci in the brain of newborn infants which he considered inflammatory in origin. These foci he describes as a fatty change in the neuroglial cells, with unequally-dilated and obstructed vessels and neuroglial cell-proliferation along the vessels. He also refers to a peculiar kind of softening in connection with these foci. When the foci are situated in the white substance of the brain they are grayish-red in color, from congestion of the capillaries. Unless the lesions have progressed to the stage of softening the brain-consistence is unaltered. Hayem, on the contrary, regards fatty degeneration of the neu-

rogliar cells as inflammatory only when associated with extreme congestion and the compound granular cell. Jastrovitz considers the condition physiological in foetal life, basing his conclusions upon a study of sixty-five cases. According to him, this fatty degeneration of the neuroglial cells does not follow inflammatory proliferation as proclaimed by Virchow, but is commonly found in certain portions of the brain, increases until the seventh month of intra-uterine life, and disappears soon after birth. Virchow's observations have been confirmed by Parrot and others, but a great difference of opinion exists regarding the primary cause of these patches. Recent studies have demonstrated a form of miliary encephalitis in the newborn which is due to septic metastasis from suppuration of the umbilical cord, and other cases are reported in which this lesion has followed diphtheria and aphthous stomatitis, some authorities regarding this form of encephalitis as the primary stage of the lesions found in a proportion of the cases of spastic hemiplegia and diplegia, and in some cases of disseminated sclerosis in children.

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ENCEPHALOCELE.—Gr., *εγκέφαλος*, the brain, and *κῆλη*, a tumor.

Definition and Varieties.—*Encephalocele*, or *hernia cerebri*, means a protrusion of a portion of brain-substance with its membranes through an aperture in the skull, congenital in origin, and usually situated in the occipital region in the median line, less frequently in the naso-frontal region, and rarely in other situations. Meningocele and hydrencephalocele are closely allied conditions. *Meningocele* means a protrusion of a portion

of the membranes of the brain through an opening in the skull, the sac thus formed being distended by cerebro-spinal fluid. *Hydrencephalocele* means a protrusion of the membranes and brain-substance, which also contains within it a cavity continuous with the lateral ventricles of the brain, and filled with cerebro-spinal fluid. The latter condition is the gravest and the most frequent in occurrence of the three, encephalocele being next in frequency, and meningocele the rarest. All of these conditions are of very rare occurrence. Forms of acquired hernia cerebri will more properly be considered elsewhere, in connection with the various causes of this condition.

Symptoms.—In the three forms enumerated the disease is congenital, and is developed at some period of intra-uterine life; and at birth presents a tumor of varying size, generally situated in the occipital region, or in the naso-frontal region in the median line. In almost all cases the hernia emerges through an opening in the line of one of the cranial sutures.

The naso-frontal hernias leave the cranium between the frontal and nasal bones and form a tumor in the median line in the region of the glabella.

The naso-ethmoidal hernias leave the cranium between the frontal and nasal bones on the one side and the lateral mass or labyrinth on the other, which is forced or displaced downward toward the nasal cavity. The tumor appears externally in the region of the border between the osseous and cartilaginous portions of the nose, hanging down toward the tip or the wing of the nose.

The naso-orbital hernias leave the cranium between the frontal, ethmoid, and lacrymal bones. In the region of the latter they enter the orbit and present at or near the inner canthus of the eye. The naso-ethmoidal and naso-orbital varieties are probably not distinguishable from each other, as they leave the

cranium at the same place, namely: the nasal notch of the frontal and the cribiform plate of the ethmoid bone. Christian Fenger (Amer. Jour. Med. Sci., Jan., '95).

Cephalhæmatoma represents one of the risks through which the child must pass during labor. The tumor consists



Palatine hydrancephalocele in a newborn child. (Virchow, *Die Krankhaften Geschwülste*.)

of an infusion of blood between the periosteum and bone, forming either two projections over the parietal bosses or more commonly a single projection upon one side. It is important to distinguish this condition from a sero-sanguinolent effusion, which is much more common, and which is present at birth. This tumor is soft, but less fluctuating, and can be indented by the finger, as in œdema. It appears on the presenting portion of the fœtus, therefore is formed before its expulsion, and disappears shortly after birth—within one or two days. It never limits itself, as does the cephalhæmatoma, to the border of the bones. The characteristics of the sero-sanguinolent tumors are exactly opposite to those of cephalhæmatoma. It is due to a circular compression at the base of the part which corresponds to the ring of the pelvis during engagement, and always appears before the presenting part. Queirel (*Annales de Gynéc. et d'Obstet.*, Jan., 1901).

Of 93 cases collected by Houel, 68 cases were occipital, 16 were fronto-nasal, and 9 occurred in other situations; while of 105 cases collected by Schatz, 59 were occipital and 46 frontal. These hernial protrusions may occur in other situations. Thus, in the frontal region instead of emerging between the cribiform plate of the ethmoid and the frontal bone, such a protrusion is sometimes located in the interfrontal fissure high up, or in the anterior fontanelle; less frequently they occur in the sagittal suture, or between the temporal and parietal bones, thus appearing upon the side of the head. The frontal tumors are smaller, as a rule, than the occipital growths, and are covered with a more vascular skin covering; so that they may give the appearance of certain forms of nævus. In extremely rare cases the opening has existed between the sphenoid and ethmoid bones, or between the sphenoid and its greater wing.



Encephalocele. (Holt, *"Diseases of Infancy and Childhood."*)

The tumor may thus appear in the pharynx, or in the mouth, or protrude through the spheno-maxillary fissure, or into the orbit, causing displacement of the eye.

The physical characteristics of the three forms of congenital tumor differ

according to the size of the opening in the skull and the nature of their contents. Owing to possible error in diagnosis, all tumors of this kind should receive most careful physical examination,



Naso-frontal meningocele. (Holt, "*Diseases of Infancy and Childhood.*")

especially if any surgical interference should be contemplated.

(a) Encephalocele presents the smallest tumor of the three, usually rounded or oval with a broad base, and having a pretty firm resistance to the touch.



Occipital meningocele. (Holt, "*Diseases of Infancy and Childhood.*")

Sometimes the tumor is marked by a median furrow, dividing it into two lateral halves. The tumor is opaque, does not fluctuate, has distinct pulsation synchronous with the heart's action, and

pressure upon it causes symptoms of cerebral compression, such as nausea, vomiting, irregular respiration, strabismus, and even convulsions.

(b) Meningocele appears as a more uniformly round or oval pedunculated tumor, usually small at birth and subsequently increasing more or less in size.

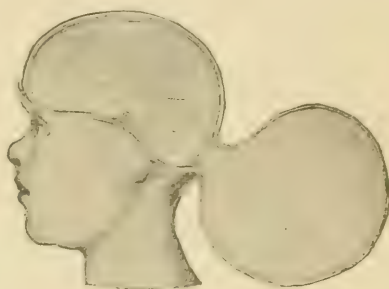
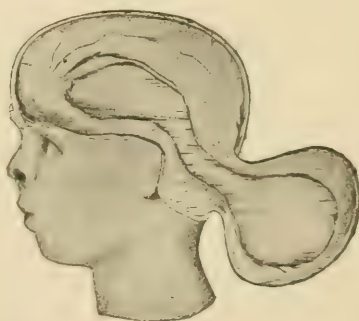


Diagram of meningocele. (Holt, "*Diseases of Infancy and Childhood.*")

It is translucent, fluctuates distinctly, does not pulsate, is made intense on the crying of the child, or during forced expiratory efforts, and it is reducible upon pressure.



Hydrancephalocele. (Holt, "*Diseases of Infancy and Childhood.*")

(c) Hydrancephalocele presents the largest tumor of the three forms of this condition. The tumor is lobulated, pendulous, and more or less peduncu-

lated; and there is fluctuation, translucency of parts of the tumor, according to the amount and location of the liquid contained within it, and usually absence of pulsation. The surface of the mass is covered with hair if the tumor is small, but if large the hair is only about its base, being absent over its fundus. It is liable to increase of size and to final rupture with rapid collapse or convulsions prior to death. Pressure does not produce the marked signs of cerebral compression observed in cases of encephalocele. In some cases some form of paralysis may also be present, with microcephalus and hydrocephalus.

Differential Diagnosis.—Any of these conditions may possibly be confounded with cephalhæmatoma, serous or sebaceous cysts, abscesses, nævi, and polypi. Such mistakes having been made, it is most important that the most careful examination should precede any surgical interference; but, with ordinary care and attention to the physical characteristics of these forms of hernia cerebri, mistakes of this kind should never occur. The diagnosis, therefore, is usually a simple matter, and is readily made upon careful examination of the tumor. The fact that these conditions usually occur in the median line, that meningocele is reducible, that encephalocele is attended by signs of cerebral compression when pressure is made upon the tumor, and pulsates distinctly, and that all of them are made tense upon forced expiration, should separate them from any of the above conditions. In many of the cases the edges of the bony opening through which the protrusion occurs can be felt by palpation, with partial reduction by pressure. Hydrencephalocele can hardly be confounded with any of the above affections, owing to its large size, its pendulous, pedunculated, and lobulated

conformation, with semitranslucency, and its strictly congenital history. All of these cases are apt to be associated with other deformities, and some form of paralysis is frequently present in cases of hydrencephalocele.

Etiology and Pathology.—The exciting causes of these three forms of congenital malformations are practically unknown. It is probable that injury to the mother may account for some of the cases. The influence of certain maternal impressions may operate here, by inducing an arrest of development.

The most widely accepted view of the pathology of these states is that they are all due to a primary intra-uterine hydrocephalus, and that the resultant increased intracranial pressure during the closure of the cranial cavity causes a portion of the intracranial contents to be forced outside, an aperture being maintained. Other possible causes are amniotic adhesions to the scalp of the foetus, and arrest of development in the bones concerned. This arrest of bony development may be caused by amniotic adhesions. However, the fact that these protrusions occur in the median line favors hydrocephalus as the causative condition.

Prognosis.—The prognosis is unfavorable, except in cases of small meningocele amenable to operation, and in cases of small encephalocele, some of which live for many years. Hydrencephalocele is usually a fatal condition, death occurring in from a day or two to several weeks.

Treatment.—Meningocele has been frequently aspirated, and the injection of iodine into the sac in the form of Morton's solution has been practiced. Many forms of operation have been tried in these cases, and successful operations have been reported from all of them, but,

even in the successful cases, chronic hydrocephalus has often followed.

Attempts at the removal of encephalocle by operation have been made by Lichtenberg, Czerny, and the author. Lichtenberg's patient died from the operation; Czerny's patient survived the operation, but died later from apparently independent causes.

Personal case in which the patient made a permanent recovery: that of a Swede, in whom was found a tumor filling the post-nasal space above the soft palate. On palpation the tumor seemed somewhat compressible, and would, upon pressure, appear to decrease in size so that it could be pushed up into the left half of the posterior nares. The pedicle could be traced to the roof of the nose. Cerebral hernia suspected. Hypodermic needle twice inserted with negative results and diagnosis of ordinary polypus and not basal hernia made. An attempt made to remove the growth in the usual way with the wire snare and the pedicle divided. After withdrawal of the snare slight hæmorrhage occurred, but neither coughing nor sneezing brought forth the tumor. The hæmorrhage soon ceased, but was immediately followed by dripping of a clear watery fluid, of which about a teaspoonful was collected. The fluid was cerebro-spinal. The basis of the plan of operation now was to secure the pedicle for transfixion and ligature as close to its exit from the cranium as possible. The operation of the osteoplastic or temporary resection of the superior maxilla as devised by von Langenbeck was accordingly executed. Ten weeks after the operation the wound was so nearly closed that collodion dressing could be applied over the fistula leading into the antrum, which remained open for about three months, but secreted little and did not interfere with the patient's work as coachman.

The microscopical examination showed distinctly that the tumor was a cysto-encephalocle. Although no layer of white brain-substance was present, there was no doubt that this cavity was a continuation of a ventricle, probably the third ventricle. Its regular shape, and

the fact of its being entirely surrounded by a layer of cortical brain-substance, made it distinctly different from the serous cavities which are found in hernias of the brain as well as of the spinal cord, developed from, or an exaggeration of, the subarachnoid lymph-spaces.

The distance between the eyes a point in diagnosis. It is possible that a basal cerebral hernia might cause a broadening of the root of the nose and a corresponding increase in the distance between the inner walls of the orbits, just as occurs in sincipital hernias. Christian Fenger (*Amer. Jour. Med. Sci.*, Jan., '95).

Treves operates in these cases only when rupture is threatened. Schatz (*Berliner klin. Woch.*, No. 28, '85) gives statistics as follows: 3 recoveries in 24 occipital tumors not operated on, and 6 recoveries from 35 operated on by injection, clamp or ligature, or excision. Six recovered out of 46 frontal tumors without operation, while 2 recovered out of 14 operated on. The tendency at present is to operate upon these cases, although the results are not very encouraging.

When the tumor is not small, it should be supported by gentle pressure,—or a collodion dressing may be applied over it, as advised by some surgeons.

In the case of a small encephalocle it is better to apply gentle pressure, and to wait in order to find out if it inclines to enlarge. In this form the patient may live many years and experience no discomfort from the condition.

Cases of spontaneous cure of encephalocle and meningocele have been reported. This is effected by gradual growth of bone around the opening, with retraction of the sac. The opening in some cases becomes entirely closed. This is, however, of very infrequent occurrence.

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ENCHONDROMA. See TUMORS.

ENDOCARDITIS. See VALVULAR DISEASES and INDEX.

ENDOMETRITIS.—Gr., ἔνδον, within, and μήτρα, the uterus.

Definition.—An inflammation or hyperplasia of the uterine mucous membrane involving, to a greater or less extent, the parenchyma of the uterus.

Varieties.—It is convenient, both in a clinical and a pathologic sense, to divide the disease into two varieties, viz.: (1) interstitial or functional endometritis; and (2) glandular or functional endometritis, or hyperplasia. Either of these two varieties may exist in the acute and chronic form, but the chronic form may follow a mild and overlooked acute attack, or may supervene in a gradual manner without being preceded by a recognizable acute attack.

There are three varieties of endometritis: the glandular, interstitial, and fungous. The form described as endometritis decidua is a combination of the glandular and interstitial forms, while gonorrhœal endometritis is of the interstitial variety and similar to senile endometritis. Winckel (Münchener med. Woch., July 31, '94).

Endometritis is exceedingly rare; only about one case in fifty that come to the clinics is really endometritis. H. A. Kelly (Med. Record, May 21, '98).

Patients with painful endometritis are apt to complain of general nervous symptoms rather than local; hence they are often regarded as purely neurotic. This error is also due to superficial examinations and the failure to test the sensitiveness of the endometrium, the uterus being regarded as normal because it is not enlarged. There is an intimate relation between the sympathetic nerves of the pelvis and the lumbar plexus, as shown by the pains on the inner aspect of the thighs in connection with painful endometritis. Sneguireff (Archiv f. Gynäk., B. 59, H. 2, 1900).

Symptoms.—The symptoms may be divided into (1) disturbances of the sexual functions, (2) intermenstrual discharges, (3) pain and discomfort in and about the uterus or radiating from the uterus, (4) reflex disturbances, and (5) general symptoms.

Menorrhagia is one of the most frequent symptoms in the early stages and in the *glandular* variety it often persists for a long time as the most prominent one. The flow may be moderately increased in amount, or be a profuse hæmorrhage with the passage of clots; it may be prolonged, or may recur too often. In the later stages of *septic* or *interstitial* endometritis the menses are sometimes scanty. In certain acute attacks the menstrual flow is suppressed.

Dysmenorrhœa is common in cases connected with flexion, puerile cervix, or inflammation of the appendages.

Dysmenorrhœa and menorrhagia from which many young girls suffer are due to endometritis, and the chief causes leading to this condition are tight corsets, exposure of the feet to wet and cold, chronic constipation. A. Laphorn Smith (Amer. Medico-Surg. Bull., May 30, '96).

Dyspareunia and sterility may be present under the same conditions.

Sterility in woman is most frequently due to catarrhal endometritis, resulting from a previous miscarriage. The principal causes are: the absence of a suitable habitat for the ovum in the uterine cavity; obstruction of the cervical canal by mucus; and increased alkalinity of the cervical secretions, corresponding to an exaggerated alkaline condition of the vaginal mucus. W. P. Manton (Amer. Jour. of Obst., No. 4, '92).

Leucorrhœa is usually noticeable in the glandular variety and in the early stages of the septic. In the former the corpus secretes a thin, and the cervix a thick, clear mucus, both of which may be transformed into minute white co-

agula, at the external os, by the acid vaginal secretion, and appear at the vulva as a white or greenish-white discharge. In some cases the mucus is intermittently tinged with blood. The leucorrhœa may last throughout the month, or only for a few days after the cessation of the monthly flow. In the septic variety the discharge is at first purulent, but later becomes muco-purulent, and in time may be mucous or even watery in character. It sometimes has a disagreeable odor.

Pain may be felt in the sacral or lumbar region, and may extend across the back or up the spine to the occipital region, or down the course of the sciatic nerve. Cutting or cramping pains across the lower abdomen or pubic region may be complained of, depending upon painful uterine contractions due to the expulsion or attempted expulsion of uterine discharges. Irritability of the bladder or rectum, or pain in the vagina or pubic bones, may be prominent. Feelings of weight in the vagina, and sensations as of prolapse of the pelvic organs are present in some cases. Intercostal neuralgia is not uncommon.

Menstrual pain of a burning or aching character may be felt in the pelvis and back, or the pain may be suprapubic and colicky. It may last one or more days or throughout the period, and even for several days afterward. When the mucous membrane is exfoliated the uterine contractions are frequent and excessively painful, and last until the membrane is expelled.

Gaseous distension of the intestines, constipation, impaired digestion—with its accompanying reflexes, photophobia, and pain in the eyes after prolonged attempts at reading—are the ordinary reflex disturbances. Mental depression, worry, and the various manifestations of

hysteria and neurasthenia are sometimes classed among the reflexes, although they are, as a rule, largely dependent upon other conditions and circumstances.

Chills, fever, and the other general symptoms of inflammation and sepsis are observed in acute endometritis.

In chronic cases anæmia and nervous debility are often present.

Diagnosis.—Endometritis must be differentiated from angioma, tuberculosis, carcinoma, and myoma of the uterine mucous membrane.

Besides the symptoms, tenderness of the uterus, as evidenced by bimanual palpation, and sensitiveness of the endometrium at the internal os and fundus, as demonstrated by the passage of the sound, are of diagnostic value. The withdrawal of the sound may be followed by a moderate flow of blood or mucus.

Differential diagnosis between catarrh limited to the cervix and cervico-corporeal catarrh: (1) thin, purulent discharge indicates catarrh of corporeal endometrium; (2) cervical catarrhs seldom occur in multiparæ; (3) reflex symptoms point to trouble of mucosa; (4) cervical catarrhs are rare in virgins, cervical and corporeal catarrh still more so. Van Tussenbroek and de Leon (*Archiv f. Gynäk.*, B. 47, '94).

Endoscopy recommended in the study of endo-uterine affections; the technique is not difficult. Bumm (*La Semaine Méd.*, June 15, '95).

[It is certainly doubtful whether the examination of the uterus by the endoscope affords information that justifies the dangers of carrying infection to the uterine cavity. E. E. MONTGOMERY, *Assoc. Ed.*, Annual, '96.]

The pronounced tenderness of the endometrium on the touch of the sound is characteristic of painful endometritis. As a rule, only certain localities (fundus and tubal insertions) give rise to the attacks of pain. The use of the curette brought recovery; a glandular hyperplasia could generally be found in the

débris. Pinkuss (Monats. f. Geb. u. Gyn., B. 11, S. 908, 1900).

It is difficult to distinguish ANGIOMA from hæmorrhagic glandular endometritis except by the aid of the curette, which, in the latter case, will bring out some of the hyperplastic mucous membrane.

In TUBERCULOSIS of the endometrium the curette will find necrotic, cheesy particles and perhaps tuberculous tissue. An accompanying bilateral salpingitis and pelvic peritonitis with encysted ascites, particularly in virgins, indicate the condition. Tuberculosis elsewhere, and a slowly progressive anæmia, add probability.

In CARCINOMA and SARCOMA watery discharges, fœtor, gradually-increasing metrorrhagia, rapid progress and the microscopical examination of the findings of the curette are diagnostic. Carcinomatous infiltration of the cervix produces a globular enlargement that affects the supravaginal portion as much or more than the vaginal. Carcinomatous ulceration is excavated, fissured, pale red or grayish, with vascular spots that are friable and bleed easily upon being touched. A tenaculum tears it easily and causes abundant hæmorrhage, but will hold firmly in an inflamed cervix. When there is cystic degeneration the tenaculum may tear out easily, but it causes a flow of mucus from the lacerated follicles with or without some hæmorrhage. The inflamed cervix is usually soft and elastic, the carcinomatous either hard or friable.

Two cases of endometritis closely simulating cancer of the fundus in order to emphasize the fact that the microscope as a means of exclusion is quite as valuable as in the positive diagnosis of cancer. The microscopical examinations of uterine scrapings in cases of suspected carcinoma may be of value in differential diagnosis either as a posi-

tive or negative factor. It is positive when the examination shows without question the presence of cancer; it is of just as great value when it as certainly reveals the benign nature of a pathological process which has given rise to symptoms characteristic of cancer. Anspach (Univ. of Penna. Med. Bull., May, 1901).

Small intra-uterine and submucous MYOMATA usually cause marked enlargement of the uterine cavity, and can sometimes be felt by the sound. Digital examination of the endometrium through the dilated and incised cervix is of great value in discovering this, as also of other conditions, although the procedure is a mutilating one and only advisable in rare instances.

Etiology.—*Acute* endometritis may result from trauma or taking cold during the menstrual congestion, such as suppression of menstruation from exposure to cold, excessive coitus, overexertion, or blows upon the lower abdomen during menstruation. It may also be caused by infection, such as inoculation by gonorrhœal pus during or following coitus, infection of retained secundines, or the extension of sepsis from vaginal inflammation.

Bacteriological examination of the endometrium in twenty-five cases of endometritis made and fourteen distinct species of micro-organisms were found. Brandt (Med. Chronicle, Apr., '92).

The pyogenic form is most common in puerperæ. The streptococcus pyogenes is nearly always the active agent, though staphylococci, gonococci, and the bacterium coli commune may be etiological factors. Döderlein (Centralb. f. Gynäk., No. 26, '95).

Endometritis is the result of infection with pathogenic micro-organisms which are carried into the uterus during the puerperal state, by means of examinations with unclean instruments; by means of sterilized instruments used in the vagina which has not been disin-

fecte; by the gonococcus in about 35 per cent. of the cases, and by the bacillus of tuberculosis in 12 per cent. Every case should be submitted to radical treatment by means of the sharp curette and drainage with iodoform gauze. J. T. Jelks (Inter. Jour. of Surg., Feb., '96).

One hundred and seventy-nine cases of puerperal endometritis studied and placed in three principal groups:—

1. Pyogenic form due to streptococcus pyogenes (74 cases); the pyogenic form due to staphylococcus pyogenes aureus (4 cases).

2. Gonorrhœal form (50 cases).

3. "Putrid" form due to saprogenic bacteria (50 cases).

Six fatal cases recorded, and in all the infection was due to streptococci. In some of the cases the infection appeared to be of a mixed form. Krönig (l'Obstétrique, Jan., '97).

Endometritis may also follow traumatism with immediate or subsequent infection, such as lacerations of the cervix during labor or by instrumental dilation, curettage of the endometrium, the introduction into the uterus of strong irritants, the use of intra-uterine stem-pessaries or poorly-fitting vaginal pessaries, irritating and unclean tampons, etc.

Experiments demonstrating the bactericidal property of vaginal secretion. With the exception of the gonococcus, bacteria cannot vegetate for any considerable length of time in the uterine canal. Menge (Deutsche med. Woch., Nos. 46 and 48, '94).

In twenty-nine cases of endometritis of body no trace of bacteria found by microscopical examination or cultivation. Disease of mucous membrane not therefore kept up by bacteria in this region. This does not exclude the fact that disease of the mucous membrane arises from acute septic or gonorrhœal infection. Bumm (Centralb. f. Gynäk., No. 26, '95).

Secretion obtained from the cavity of the uterus of 60 cases and examined microscopically and by cultures with the following results: In 21 patients, mostly

cases of fungoid endometritis, no bacteria were found, and in most of the cases repeated examinations gave negative results. Seven of the 21 cases showed the presence of bacteria of some kind after frequent intra-uterine manipulation, probably due to inoculation by the instruments. The bacteria, however, were not pathogenic. The 39 remaining cases in which bacteria were found may be divided into two groups: those in which staphylococci were found and those in which non-pathogenic bacteria were present. Streptococci were absent in all cases examined. S. Gottschalk and Robert Immerwahr (Archiv f. Gyn., No. 3, p. 406, '96).

Case of a woman in which cause of endometritis was found to be the presence of oxyuris vermicularis in the vagina and uterus. E. M. Simons (Centralb. f. Gynäk., July 1, '99).

Traumatism or reinfection may convert a chronic into an acute endometritis. Poisons, such as phosphorus and the essential oils, are occasional causes.

Glandular endometritis may be caused by interference with the menstrual function by taking cold, overexertion, coitus, laborious or sedentary occupations, uterine displacements, obstinate constipation, etc. The same causes may act during puerperal involution or after abortion.

There is no specific organism for endometritis of pregnancy, which is always secondary and always in existence before the pregnancy. The glandular form of endometritis is an hyperplasia of the mucosa, of which the causes act indirectly upon the endometrium, such as onanism, sexual excesses, psychical influences, diseases of the ovaries, etc. The interstitial form is the result of infection or direct interference with the endometrium. The glandular form is more frequently the cause of sterility than the interstitial variety. Veit (Zeit. f. Geburts. und Gynäk., B. 32).

Excessive coitus, masturbation, ovaritis, uterine fibroids, inflammation in

neighboring pelvic organs, and interference with uterine drainage by stenosis may lead to it.

Gonorrhœa of the uterus produces in all cases an inflammation of the mucous membrane, designated as an interstitial endometritis with suppurative catarrh, and in a not inconsiderable number of cases the chronic course leads to increase in the number of glands. Wertheim (Centralb. f. Gynäk., No. 26, '95).

Mycosis of the cervical canal is probably a more frequent cause of obstinate catarrh than is generally supposed. Calpe (Centralb. f. Gynäk., No. 27, '95).

Endometritis fungosa may sometimes be found in virgins. The first characteristic symptoms appear with the first menstruation. Infection with micro-organisms, masturbation, and traumatism are etiological factors. Latour (Revue Inter. de Méd. et Chir. Prat., No. 18, '96).

Number of cases observed in which there was chronic catarrhal inflammation of the virgin uterus, and such marked eversion of the cervical lips as to give the appearance of an ordinary puerperal laceration of the cervix. In most instances the excision of the hypertrophic mucous membrane and curetting of the endometrium will effect a cure. P. F. Mundé (Amer. Medico-Surg. Bull., May 30, '96).

Underlying a virginal or senile endometritis there is frequently a condition of malnutrition, spoken of in a general way as "lithæmia." Matthew D. Mann (Amer. Medico-Surg. Bull., May 30, '96).

Chronic septic inflammation may result from one or more acute attacks or from infection by objects introduced into the vagina or uterine cavity whether by operation, examination, or improper attempts at medication.

Some cases of fœtid endometritis in aged women may be due to recurrence of simple endometritis of earlier life, or may be looked upon as the result of a necrotic process accompanying the elimination of fibromyomata from the uterus. It appears from five to fourteen years after the menopause, and attacks women

who have borne children rather than nulliparæ. Maurange (La Presse Méd., Jan. 26, '95).

Case of endometritis in a person who was undoubtedly a virgin and who had not been subjected to previous local instrumentation never seen. Howard A. Kelly (Amer. Medico-Surg. Bull., May 30, '96).

Bacterial infection is by no means necessary for the production of many cases of chronic endometritis, although this condition may be the result of invasion by organisms, especially those of sepsis and gonorrhœa. Warbasse (Amer. Jour. Med. Sci., Feb., '98).

Pathology.—The mucous membrane of the cervical cavity presents the same changes as those of other mucous membranes.

Cervical endometritis exhibits anomalies of secretion with reddening and swelling of mucosa. Gradual narrowing of os; retention of secretion; contraction. In consequence of retention, atrophy of mucous membrane. Ruge (Centralb. f. Gynäk., No. 26, '95).

Ruge divides endometritis into the glandular, interstitial, and mixed varieties. The glandular variety is characterized by an increase of the adenoid elements, the interstitial variety by an increase in the fibrous tissue, with more or less destruction of the glands; in the mixed form there is an increase of both the interstitial and the glandular structure. H. J. Boldt (New York Med. Jour., Dec. 20, 1902).

The alkaline mucous discharge that hangs from the cervix, together with the congestion and infiltration, often produces an exfoliation of the squamous epithelium of the vaginal portion, with reproduction in the form of cylindrical epithelium. This condition is called *simple erosion*. The infiltration and swelling of the submucous tissues causes more or less of a rolling out, or eversion, of the mucous membrane of the cervical cavity, which is more pronounced on a

Fig.2



Fig.3

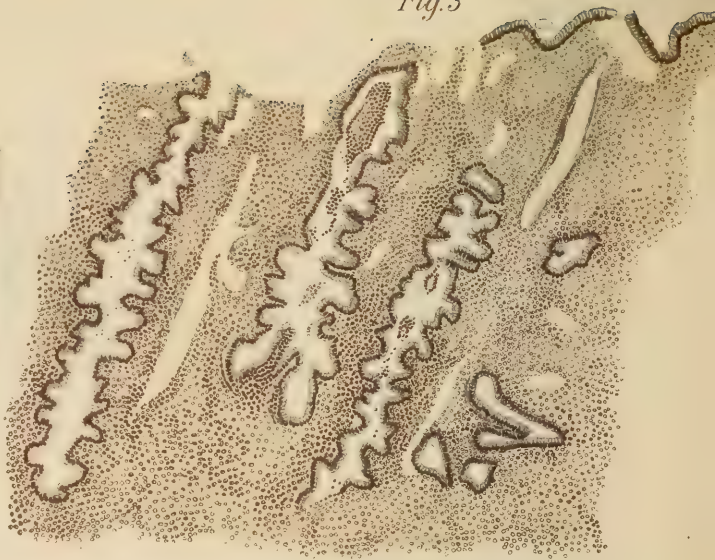


Fig.1

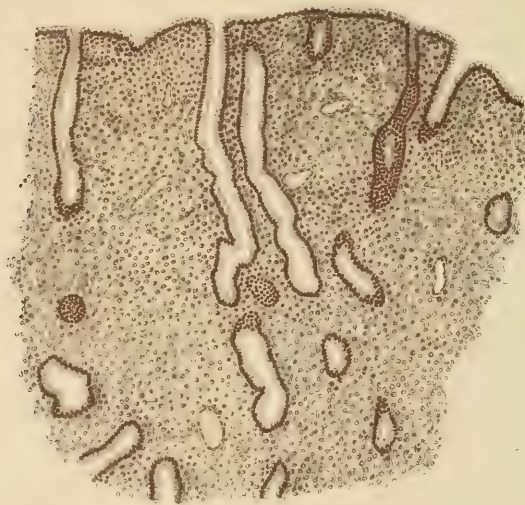


Fig.4

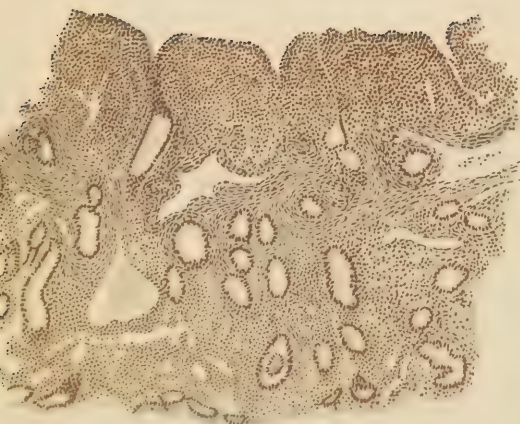
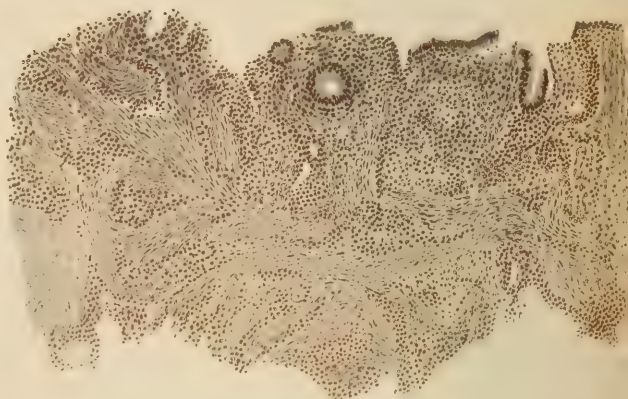


Fig.5



Comparative Histology of Endometritis (Zweifel.)

Fig.1. Normal Mucous Membrane, Fig.2. Beginning Erosion of Cervix, Fig.3. Glandular Endometritis, Fig.4. Acute and Chronic Interstitial Endometritis, Fig.5. Chronic Interstitial Endometritis.

lacerated cervix. More or less folding of the mucous membrane may give the appearance of a papillary or granular surface, which is called *papillary erosion*. Pockets may form in these folds and, together with the everted cervical glands, may become occluded, giving rise to a cystic condition called *follicular erosion*. These follicles may become so numerous, or one or two may become so large, that the normal cervical tissue is either displaced or replaced by them, and *cystic degeneration* thus results. Sometimes localized hyperplasias are present, with projection of glandular polypoid masses. (See *Colored Plate*.)

The uterine mucous membrane above the internal os has somewhat different characteristics from those of other mucous membranes which have different functions. Its glands are simple depressions or epithelial tubules that extend to the muscular walls underneath. Instead of being imbedded in firm connective tissue as are the cervical glands, they are surrounded at their inferior extremities by muscular fibres projecting from the muscular walls, which constitute an ill-defined muscular structure called the *muscularis mucosæ*. In the interglandular or intertubular spaces or fluid are found delicate connective-tissue fibers and round or oblong cells resembling lymph-cells.

When subjected to intense prolonged congestion an infiltration of serum takes place, raising the epithelial surface and causing a proliferation of the epithelial cells, with enlargement, as well as wrinkling, twisting, or bending of the glandular tubules; or in severe cases a formation of new depressions or tubules, some of which may become closed by bending or swelling at their orifices.

It is not uncommon to have variations in the number, shape, and size of the

uterine glands, and it is not right to call this endometritis even if it is clinically so. William H. Welch (Med. Record, May 21, '98).

In some cases the epithelium proliferates within the glands, forming more than one layer. Round-cell infiltration and formation of new interglandular tissue may take place, particularly if mild septic infection intervene. In such cases agglomerations of glands surrounded by a small amount of connective tissue project from the surface, forming polypoid masses, which may spring from every part of the mucous surface.

Histologically, the epithelium covering the mucous surface is composed chiefly of large, nucleated leucocytes; it is swelled and somewhat distorted. The uterine glands may be normal in part, but the mouths of the glands are very much swelled and there are many pus-cells present. In chronic endometritis the mucous membrane is highly granular and has an appearance like that of polypi. The term granular endometritis is highly improper, and should be abandoned. Only forty-nine cases of endometritis found in eighteen hundred gynaecological cases at the Johns Hopkins Hospital. The treatment consists in dilating and curetting the uterus. Thomas S. Cullen (Med. Record, May 21, '98).

The uterine walls are usually also congested, and some round-cell infiltration takes place about the blood-vessels, which, in time, leads to the formation of adult connective tissue. Contraction in this connective tissue may finally cause anæmia of the uterine walls and more or less atrophy of the muscular fibres.

The mucous membrane is hyperæmic, softened, thickened, and dark red in color. In places it may have a mottled appearance, due to minute extravasations of blood. The surface is smooth, sometimes irregular, and is moistened with a thin, clear, grayish or pinkish

mucus. The pouting mouths of the congested and enlarged glands are visible. The uterine walls are slightly thicker and the uterine cavity somewhat longer than normal (from $2\frac{1}{2}$ to 3 inches deep from the external os to the fundus). This condition is that of *glandular* endometritis, or *hyperplasia* of the endometrium, and is seldom the result of infection. It is, as a rule, chronic.

During the menstrual periods the congestion is intense, and there is more or less extravasation of blood in the interglandular spaces, and an extensive exfoliation of the epithelium.

When the congestion results suddenly from causes acting during or just before the menstrual period, it is also intense and accompanied by interglandular extravasation and blood-stasis that interfere with the menstrual discharge, and which, if not relieved, runs into the chronic form.

In *acute septic* endometritis the blood-vessels of the endometrium are engorged and increased in number. There is considerable exfoliation and proliferation of the epithelial cells, sometimes to such an extent as to cause a superficial necrosis. The interglandular spaces are crowded with round cells, leucocytes, and cocci which may extend into the muscularis mucosæ and, if streptococci be present, a short distance into the uterine walls. Congestion, extravasation of blood, serous and round-cell infiltration take place throughout the uterine tissue, and a fibrinous exudate may appear on the peritoneal surface.

Eighteen cases of infectious diseases, showing that the blood-vessels of the endometrium were intensely congested, particularly the small veins and the capillaries. Ecchymoses, either in patches or disseminated all over the surface of the mucous membrane, were present. The glandular epithelium was swelled,

the cells were desquamated, and the lumina of the glands filled with cells, mucus, and blood-corpuscles. The glands frequently penetrated very deeply into the muscular layer, this being a characteristic sign of endometritis. An hæmorrhagic endometritis was found to be present in all of these cases. Massen (Gaz. de Gyn., Mar. 15, '91).

There is a more or less abundant flow of pus from the endometrium.

In *chronic septic* endometritis round cells and leucocytes crowd the interglandular spaces, compressing the glands and in places penetrating and destroying them. After a time the formation of contracting adult connective tissue compresses and obliterates some glands, and obstructs the mouths of others, converting them into small cysts. The epithelium in the atrophic glands and on the surface also degenerates; so that in old and senile cases the mucous membrane may be represented by a thin layer of sclerotic connective with only vestiges of epithelial structure.

The uterine walls, at first hyperæmic and infiltrated to a greater or less depth with serum and round cells, are thicker and softer than normal, but later, owing to the contraction of the inflammatory tissue, become hardened. The atrophy of the muscular tissue and absorption of the serum, as well as the senile changes, may finally lead to a diminution in size of the entire organ.

Endometritis occurring in connection with abortion may interfere with the atrophy of the decidua, and masses of decidual cells may be found in the endometrium in connection with the round-cell infiltration.

In some cases the menstrual congestion is so great that an acute attack is practically lighted up at each period. The stroma-cells are enlarged and resemble decidual cells, and the tissues are

crowded with leucocytes. The congestion is so great that there is an abundant extravasation of blood in the interglandular spaces, which loosens the superficial portion to the extent of causing its exfoliation in places or even entire, as a more or less complete cast of the uterine cavity.

After the menopause the cervix may become stenotic, and the discharges be retained. The uterine cavity may then become distended, and the uterine walls attenuated by an offensive and purulent fluid.

The menopause does not exercise a curative influence upon endometritis and its resulting leucorrhœa. Jacobs (Amer. Jour. Med. Sciences, Apr., '94).

The characteristic pathological features of acute senile endometritis are a thickened endometrium, the free surface of which is devoid of its epithelial layer; increased vascularity with peculiar arrangement of small blood-vessels; small round-celled infiltration; diminished glandular elements; degeneration of the coats of the arteries of the muscular layer of the organ; in not one section examined from various parts of the organ could there be found any increase of connective tissue. L. H. Dunning (Jour. Amer. Med. Assoc., Nov. 3, 1900).

Prognosis.—The prognosis of acute metritis in the puerperal state or after abortion is grave. The patient may die of septicæmia, or the disease may extend to the Fallopian tubes, ovaries, and peritoneum, or into the veins or lymphatics of the broad ligament, or it may result in chronic endometritis and subinvolution.

When not connected with pregnancy the disease seldom terminates fatally, but is apt to extend to the adnexa or become chronic.

Acute cervical metritis may end in recovery, but, as a rule, becomes chronic.

Chronic cervical metritis may get well, but, as a rule, it persists for a long time.

It can ordinarily be cured either by local treatment or operation.

Chronic corporeal endometritis of the septic variety is apt to get well if there is good drainage through the cervix. Without adequate drainage it becomes chronic and is liable to spread to the adnexa.

In the non-puerperal uterus the risk of the inflammation spreading to the tubes is little save when the cervical canal is obstructed or the infection gonorrhœal in nature. W. P. Carr (Virginia Med. Semimonthly, Jan. 8, '97).

The prognosis of foetid endometritis is favorable, though recurrence may occur after curettement. Mansange (Arch. de Tocol. et d'Obstet.; Centralb. f. Gynäk., No. 21, '97).

In cases of long standing the septic condition can be removed, but the endometrium and myometrium can seldom be restored to a normal state.

The sterility is apt to be permanent.

Chronic glandular endometritis can generally be cured by treatment. Mild or recent cases may get well spontaneously, but severe cases usually persist for a long time, or until the menopause.

Treatment.—For *acute metritis* due to suppression of the menses the flow should be re-established if possible in the early or congestive stage. As soon as possible after the suppression the patient should take a warm sitz-bath (100° F.), and go to bed. Hot drinks, hot poultices to the abdomen and groins, and hot-water bags or bottles to the feet and legs should be employed. In married women scarification of the cervix may be used with benefit. The production of slight nausea by means of tartar emetic, ipecac, or lobelia is useful as a sedative to the congested pelvic organs. If the menstrual flow is re-established by these means within a day or two, the patient may leave the bed after the flow has ceased, but should lie down two or three hours in the middle

of each day, and take but little exercise for three or four weeks. At the time of the next period she should keep to the bed and repeat the hot applications, etc., if the flow does not appear on time. The bowels should be kept open by salines.

If the menses are not re-established within two or three days after their suppression, the patient should remain in bed for a week or ten days, apply counter-irritants over the iliac and suprapubic regions, and take copious hot douches (115° to 120° F.) two or three times daily in the recumbent posture. She should secure a daily evacuation of the bowels and, if practicable, introduce small cotton tampons, saturated with a 10-per-cent. solution of ichthyol in boiled glycerin, high up into the vagina every other day, and leave them for about eighteen hours. Tonics and an easily-digested diet should be prescribed.

Acute metritis following labor or abortion calls for a thorough evacuation of the uterus by the *fingers* or curette, and, if septic symptoms persist, antiseptic intra-uterine douches every twelve hours ($1/3000$ of corrosive mercuric chloride followed by sterilized water or 1-per-cent. creolin) and vaginal douches of the same character every six or eight hours.

Treatment of beginning endometritis by means of medicated steam recommended. Resorcin at $1/20$ and varying in temperature from 104° to 140° F. is used. But slight dilatation of the cervical canal is required, and accidents are thus avoided. The exudations become coagulated and are excreted by means of contractions, causing a mild form of colic. Sordes (*Jour. de Méd. de Bordeaux*, Sept. 1, '95).

Excellent results obtained in seven out of eight cases of septic endometritis after labor and abortion by the injection of superheated steam into the uterine cavity. The apparatus consists of a metal can with a spirit-lamp and a thermometer which registers up to 200° C.,

some rubber tubing, and a catheter. The application lasts about half a minute, and never over a full minute. By means of a tap, the current of steam can be interrupted while the catheter is being adjusted before use, lest scalding or burning should occur. The temperature of the steam must be a little above boiling-point, about 110° C. The jet of steam is followed by no bad effects and gives little or no pain. Uterine contractions are actively stimulated and ill-smelling discharges cease. Steam kills the bacteria in the endometrium, and as it coagulates albumin all blood-vessels and lymphatics are sealed up, and fresh granulations can develop under the protective covering. Kahn (*Centralb. f. Gynäk.*, No. 49, '96).

Excellent results obtained from tincture of iodine in post-partum endometritis. It acts best when used in the early stages and as often as once or even twice daily. As soon, however, as the signs of acute inflammation subside and the secretion diminishes, the remedy should be applied less frequently. Pains of varying character usually follow this mode of treatment. The method of application is as follows: The patient lies on her back, and a speculum is introduced into the vagina. If the cervix is blocked with mucus, the os is drawn down with a volsella, the portio vaginalis is irrigated, and the parts dried with aseptic cotton-wool; the canal is then swabbed with the pure tincture of iodine. In cases in which the corpus uteri is also involved the remedy is applied in the same way as to the cervix. A. Solowjev (*Wratch*, No. 12, '97).

Bromine-vapor most satisfactory agent in the treatment of endometritis. It is introduced into the uterine cavity through a double-current catheter attached to an atomizer, diffuses rapidly, and exerts a remarkable curative action in cases of acute endometritis and salpingitis. Nitot (*La Gynécologie*, Oct., '97).

A steam-jet at a temperature of 100° C. in endometritis and in various septic and chronic inflammatory conditions advocated after use in thirty-one cases. Used carelessly, there is some danger of

obliterating the lumen, but with ordinary precautions it is perfectly safe. Johnson (*Boston Med. and Surg. Jour.*, Mar. 16, 1900).

When the attack follows an operation, an ice-bag should be kept on the lower abdomen for twenty-four or thirty-six hours, the infected surfaces be thoroughly disinfected by a strong antiseptic, and one of the above-mentioned antiseptic douches be used either to the endometrium or vagina as required.

As the inflammation subsides, hot douches, laxatives, tonics, rest in bed, etc., are indicated.

In chronic uterine inflammation all causes of the diseases and all conditions that perpetuate it should receive attention.

Septic forms require active antiseptic treatment. In those forms of chronic endometritis in which hæmorrhage is a prominent symptom, especially where an exact diagnosis is required, the curette is advisable. Where leucorrhœa is the chief characteristic, or where the curette has failed, a powerful caustic is required; and, of those which have proved effectual, chloride of zinc is perhaps the most certain. But we may hope in the near future to see it replaced by some better method, possibly by formalin and atmocausis. Symly (*Glasgow Med. Jour.*, May, 1902).

Displacements should as far as possible be corrected, stenosis relieved, and pelvic inflammatory conditions and tumors be treated or removed.

Most marvelous results achieved in hæmorrhage depending upon chronic endometritis with chronic peritonitis, by the hypodermic use of a solution containing 1½ drachms each of crystallized phosphate and sulphate of soda dissolved in 4 ounces of distilled water. From 1 to 1½ drachms of this solution is to be injected into the buttock or thigh twice a week. The solution must be made fresh and filtered each time. Chéron (*Jour. Amer. Med. Assoc.*, Apr. 28, '88).

Application of an ethereal solution of iodotorm to the cervical canal recommended in obstinate cases. Doléris (*Bull. Gén. de Thé.*, No. 11, '97).

The patient should remain in bed during a portion or all of the menstrual period, and take more than ordinary care of herself after abortions or confinements.

When menstruation is imminent or present, treatment should be withheld. An exception to this rule would obtain should the flow be very profuse or protracted. In the presence of an acute inflammatory process intra-uterine treatment should be withheld. In malignant disease of the cervix, the possibility of a severe hæmorrhage attending local treatment of whatever character must be anticipated and provided for. In all cases the risk of inflammatory reaction in pelvic structures remote from the cervix must be taken into consideration. Currier (*Trans. Med. Soc. State of N. Y.*, Feb., '90).

Stress laid on the complications which endometritis may set up in a patient who becomes pregnant. The acute form is generally secondary. Chronic endometritis attacks the decidua vera. The cause of endometritis is usually gonorrhœa. Syphilitic endometritis is probable. Endometritis cannot be treated as long as the pregnancy lasts. Only when syphilis is suspected can benefit be derived from drugs. After delivery or abortion the endometritis can be treated by the free use of the curette. The increased vascularity of the decidua vera explains the frequency of hæmorrhages during pregnancy. The decidua reflexa is rarely attacked; hence the placenta is usually found healthy, and the child may be delivered alive. Tarnier (*Jour. des Sages-femmes*, Jan. 1, '94).

Chronic glandular endometritis, alone or in connection with chronic septic or interstitial endometritis, and all menorrhagic cases uncomplicated by pelvic peritonitis should be curetted.

Dilatation, curetting, irrigation, and draining recommended as the best and most rapid method of obtaining a cure. Waldo (*N. Y. Med. Jour.*, Feb. 13, '92);

Baldy (Med. and Surg. Rep., Mar. 12, '92); Noble (Annals of Gynecology and Pædiatry, June, '92); Garrigues (Times and Register, Apr. 30, '92); Gossmann (Münchener med. Woch., May 31, '92); Thielhaber (Münchener med. Woch., June 28, '92); Goffe (Virginia Med. Monthly, Sept., '92).

Sixty-five cases of endometritis fungosa treated by curetting; 92.2 per cent. completely cured; 13.8 per cent. much improved. Should be performed with patients in Sims's position. Hans Vogelbach (Inaugural Dissertation, '94).

The most thorough results are obtained when both the curette and the sharp spoon are used, especially the smallest-sized instruments, which can be inserted into the cornua of the uterus and between the rugæ. Where there is marked glandular hyperplasia, early recurrence is apt to follow the most vigorous scraping unless the raw surface is thoroughly cauterized at once. R. Werth (Archiv f. Gynäk., B. 49, H. 3, '95).

In 297 cases treatment consisted of dilatation and curettage of the uterine cavity, followed by thorough application to the endometrium of 50-per-cent. solution of chloride of zinc in the worst cases, and of a solution of iodized phenol in milder cases. A sterilized drain was then inserted through the internal os, the patient put to bed, and all precautions taken against inflammatory reaction. A repetition of the cauterization with milder solution, if thought best, usually resulted in a permanent cure in the course of two or three weeks. There were 197 cures and 94 cases of improvement out of 297 operations, only 6 being mentioned as discharged unimproved. The best hope for a permanent cure of chronic endometritis would result from impregnation and normal delivery. Paul F. Mundé ("Report of Gynecological Service at Mount Sinai Hospital," '95).

In acute catarrhal endometritis electricity is an effective remedy, faradization and the negative pole of the galvanic current fulfilling the requirements of local treatment. In chronic catarrhal endometritis the positive pole of the galvanic current and zinc electrolysis, com-

bined with faradization, are also effective. Acute septic or specific endometritis demands gentle dilatation and thorough irrigation with antiseptic solutions. In chronic endometritis resulting from septic or specific infection, curettage, gauze drainage, and subsequently irrigation. Senile endometritis can best be overcome by dilatation and drainage brought about by means of the negative pole of the galvanic current, and, when necessary, irrigation of the cavity with a saturated solution of boric acid or Thiersch's solution. A. H. Goelet (Amer. Jour. of Obstet., Sept., '95).

Curettage has proved disappointing; if the infection of the mucous membrane is recent, curetting is very liable to open up new channels of infection, carrying the inflammation to deeper parts; if, on the contrary, the infection is an old one, the deepest portions of the endometrium have probably become affected, and those layers curettage could not remove without destroying the entire membrane. In cases of septic and of acute puerperal infection, curettage is, therefore, useful only for the purpose of removing foreign material, retained and adherent *débris*, etc. H. T. Byford (Wisconsin Med. Recorder, iii, No. 11, 1900).

When the curette is employed due care should be exercised. Rough manipulation and undue pressure upon the uterine surfaces have been followed by untoward results. Curettage should be avoided when there is tenderness in the tissues beside the uterus.

Temporary uterine paralysis occasionally occurs during the operation of curetting under chloroform narcosis, which might lead one to think that he had perforated the uterine wall and was moving the curette freely in the peritoneal cavity, were it not for the absence of shock, as manifested by the normal pulse, respiration, and appearance of the patient. Geyl (Arch. f. Gynäk., H. 3, '88).

Four cases noted where death has occurred from septic peritonitis after curetting. Reeves Jackson (Annals of Gynec., Apr., '88).

Case of death reported resulting from an intra-uterine injection of perchloride of iron. The patient was curetted for endometritis, and, owing to the bleeding, the following day iron was carefully injected drop by drop. She died two hours later. At the post-mortem clots were found in the uterus and thrombi in the iliac veins. Pletzer (*Provincial Med. Jour.*, Aug., '92).

The greatest danger of the curette does not lie in perforating the walls of the uterus, but in salpingitis, the excitation of peristaltic movements, and the forcing of material into the peritoneum. The worst procedure that can be imagined in this connection is to follow curetting by injection. Landau (*Med. Press and Circ.*, Dec. 5, '94).

Case in which perforation with curette ended in death. Raffay (*Thèse de Paris*, '95).

[Uterus punctured in a number of cases and in none of them have any abnormal symptoms resulted. E. E. MONTGOMERY, *Assoc. Ed.*, Annual, '96.]

Regeneration of endometrium after curetting varies widely, according to manner in which operation performed. Where there is marked glandular hyperplasia, early recurrence apt to follow most vigorous scraping unless raw surface cauterized at once. When liquor ferri applied after curetting, regeneration of epithelium delayed. R. Werth (*Archiv f. Gynäk.*, B. 49, H. 3, '95).

Fifteen days a minimum limit for the uterine mucosa to reproduce itself so as to be physiologically active after curetting. Bossi (*Gaz. degli Osp.*, Feb. 2, '95).

Exfoliative endometritis and polypoid endometritis may require more than one curettage.

In a large proportion of cases the cervical canal is small or bent, and must be kept dilated for several weeks subsequently to promote uterine drainage.

Introduction of a gauze pad or drain into the non-puerperal uterus for the purpose only of drainage is unnecessary and possibly open to objection. While the presence of a pad of gauze in a flabby, septic uterus after curetting may

produce contraction of that organ, still it acts as an obstacle to the escape of septic discharges. H. C. Coe (*Amer. Gynec. and Obstet. Jour.*, June, '95).

Iodoform-gauze packing does not drain at all. H. J. Boldt (*Amer. Jour. of Obstet.*, Sept., '95).

Term "packing" a misnomer. Tight packing only indicated in certain conditions to stimulate contraction of uterus. Goelet (*Amer. Jour. of Obstet.*, Sept., '95).

In others it is necessary to use strong astringents and antiseptics to the endometrium, to counteract the tendency to a recurrence of the hyperplasia or the sepsis.

The hot vaginal douche twice daily acts beneficially as a sedative to the pelvic circulation, and aids in keeping the vagina clean.

Local treatment may be commenced in two or three weeks after the operation. If the cervix is small or bent, a round dilator, or male urethral sound No. 12 to No. 15, should be passed through the internal os once or twice a week. In order to avoid infection, the patient should take a large hot vaginal douche shortly before the treatment, and the gynecologist should wipe out and disinfect the vaginal fornices and cervix through the speculum before introducing the disinfected sound.

After the sound is withdrawn a 50-per-cent. solution of ichthyol in glycerin may be applied to the endometrium, or, if the case has been an hæmorrhagic one, pure lysol or carbolic acid, or a 20-per-cent. solution of chloride of zinc, every ten days to two weeks.

Action of the sulphate of copper is a superficial one, not producing the deep eschar made by chloride of zinc, and it is just as effective as zinc, and does not produce atresia of the cervix. Cases cured by the copper treatment in from four to twenty-five days. Only one application was made. As a preliminary

step, strict antiseptics of the genital tract recommended, rest in bed, giving bromide one day previous, repeating it, and, if necessary, a uterine injection of chloral. Arnaud (*Bull. Gén. de Thér.*, May 15, '92).

Carbolic acid most efficient and safest application. Does not burn deeply enough to destroy submucous tissue. Not good practice to make traction upon organ and pack it every other day. A. P. Dudley (*Amer. Jour. Obstet.*, Sept., '95).

Treatment by chloride of zinc given up because of the tendency of this agent to produce cicatrization of the surface. A. Jacobi (*Med. Record*, Oct. 19, '95).

More general use of nitrate of silver advocated in the treatment of endometritis. The application of the nitrate of silver should be made carefully and thoroughly, and to do this it is absolutely necessary that all unhealthy secretions should be removed previously from the interior of the uterus, and the latter be left clean and dry. For mild cases and those seen early 5- or 10-grain solution of nitrate of silver used, but the more chronic cases require much stronger solutions or even a light touching with the solid stick. William H. Robb (*N. Y. Med. Jour.*, Dec. 5, '96).

Applications of nitrate of silver are followed immediately by an apparent improvement or cure; but further observation will show that the treatment has left an atrophic, non-secreting, and irritable endometrium. There is no such objection to the use of the curette. L. J. Brooks (*N. Y. Med. Jour.*, Dec. 5, '96).

Three-per-cent. solution of lactic acid injected into the vagina overcomes the odor that may be present in cases of leucorrhœa, changes the color of the discharge, and may be used without danger in ambulatory practice and in cases of salpingo-oöphoritis. In certain cases the intra-uterine employment of a stronger solution may be substituted for the use of the curette. Ilkewitsch (*Centralb. f. Gynäk.*; *Texas Med. News*, Dec., '97).

Naphthalin gives excellent results in cases in which there is no general septicæmia. After drying the endometrium with dry tampons, or curetting in re-

tained placenta, a long strip of iodoform gauze (3 per cent.) is dipped into ichthyol-glycerin (1 to 8), squeezed out, and powdered abundantly with finely-powdered naphthalin. This strip is then used to tampon the uterus, leaving the tampon in position for from six to twelve hours. The temperature usually falls to normal two or three hours after removing the tampon; the discharge loses its fætidity and recovery is inaugurated. If this does not occur, a second tampon should be inserted twelve hours after the removal of the first. Kirzner (*Med. News*, July 28, 1900).

When there is tenderness or irritation in the tissues beside the uterus, curettage and intra-uterine medication are liable to do more harm than good. In such cases a copious hot vaginal douche (120° F.) should be taken at or near the noon hour, followed immediately by two hours of rest in the recumbent position, and another douche at bed-time followed by the introduction into the vaginal vault of a tampon saturated with a 10-per-cent. solution of ichthyol in glycerin. The tampon is removed when the noonday douche is taken.

Laxatives, tonics, massage, regulated out-of-door exercise, and restriction of coitus are useful adjuvants.

Good results from intra-uterine galvanism. Laphorn Smith (*Amer. Jour. of Obstet.*, Sept., '95).

For catarrhal endometritis an hypodermic of strychnine and atropine each morning, and at night a cold salt-water bath followed by vigorous rubbing with Turkish towels advocated. J. E. Free (*Amer. Jour. of Obstet.*, Mar., '96).

Endometritis with stenosis and pyometra (so-called senile endometritis) should be treated on the same principles as any pus-cavity, viz.: dilatation of the cervix for drainage, and the washing out of the uterus with antiseptic solutions once or twice daily.

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